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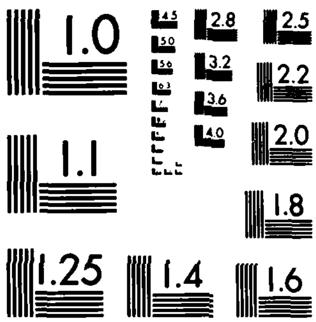

MICROCOPY RESOLUTION TEST CHART
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AD-A145 005

SYNERGY, INC.

OP-914/Synergy, Inc.
DEVELOPMENT OF NAVY METHODOLOGIES FOR RELATING LOGISTICS RESOURCES TO MATERIEL READINESS*

Deliverable Item 0002AN
Navy Analysis Methods

Task

Final Report

2337 18th Street, NW
Washington, DC 20009

UNCLASSIFIED
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This report describes the development of two capability assessment models built under the CAPLOG project. The first model assesses reparable spare parts availability and the effect on aircraft capability. The second model evaluates threat-oriented munitions availability and the corresponding effect on Navy capability. These models are designed to be used as programming support tools, which display the effect of funding on Navy capability.

Both the spares and munitions assessment models were developed in a fashion which would allow results to be combined in a balanced resource format. For example, the same scenario and force structure assumptions were used as drivers for both models. The balanced results can then be portrayed as an "envelope of capability" based upon resource levels of two different commodities.

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DEVELOPMENT OF NAVY METHODOLOGIES FOR RELATING LOGISTICS RESOURCES TO MATERIEL READINESS*

Deliverable Item 0002AN
Navy Analysis Methods

Task

Final Report

April 8, 1984

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DEVELOPMENT OF NAVY METHODOLOGIES FOR RELATING LOGISTICS RESOURCES TO MATERIEL READINESS

Navy Analysis Methods

Final report shall summarize Items 0002AC, 0002AD, 0002AF, 0002AG, 0002AK, and 0002AL.

Final report shall incorporate any recommendations and/or changes suggested by the Contracting Officer's Technical Representative.

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EXECUTIVE SUMMARY

This report describes the development of two capability assessment models built under the CAPLOG project. The first model assesses reparable spare parts availability and the effect on aircraft capability. The second model evaluates threat-oriented munitions availability and the corresponding effect on Navy capability. These models are designed to be used as programming support tools, which display the effect of funding on Navy capability.

The aircraft spares capability assessment model assesses various scenarios of peace and wartime (with varying lengths of time), different amounts of flying hour requirements for specific aircraft (and therefore spare parts), and examines the effect that various budgets have on the resulting capability. This prototype model is currently operational. It is being used for the F-14 aircraft.

The munitions model's work is more conceptual and focuses on air-to-air munitions. Two approaches to this model have been described here. The first approach is an applied model which was developed in order to obtain answers quickly, using available data and expert judgement. The second approach is an unconstrained R&D methodology which should yield more accurate results. In this example, it uses the F-14 and F-4 aircraft, and the Sparrow, Phoenix, and Sidewinder missiles.

Both the spares and munitions assessment models were developed in a fashion which would allow results to be combined in a balanced resource format. For example, the same scenario and force structure assumptions were used as drivers for both models. The balanced results can then be portrayed as an "envelope of capability" based upon resource levels of two different commodities.

I. INTRODUCTION

Synergy has developed two capability assessment models for Navy aircraft. One assesses spare parts, and the other, munitions.

Section II describes the background on this approach. It includes a description of why such capability assessment tools are required and how they can be used.

Section III presents the model developed to assess reparable spare parts availability and the corresponding effect on Navy capability. This section contains a history of the CAPLOG spares module development plus sample model reports and computer source code for the model.

Section IV describes the conceptual framework and a prototype methodology for a munitions availability model that would assess the resulting impact on capability. This section presents two approaches. One is designed to obtain quick results using available information. The other is more analytical and specifies the exact information needed in order to obtain results.

Section V presents possibilities for future work on these models. It describes possible extensions, improvements, and further applications of these two capability assessment tools.

II. BACKGROUND

This final report describes what has been done for the Navy on development of two logistics capability assessment models. The first model assesses reparable spares, and the second, air-to-air munitions. These models are designed to assess the effect of spare parts and munitions availability on Navy wartime capabilities under a variety of scenario assumptions. This provides support for logistics budgeting by estimating the budget for spares and munitions required to accomplish a particular set of plans, and the effect on capability if funding is not available. Display techniques are available to support analysis and funding requests for spare parts and munitions.

For the past ten years, the U.S. Air Force in its Logistics Capability Measurement System (LCMS) project has developed striking and novel methodologies for relating logistics resources to materiel readiness in both peace and war. Some of the analytical work done under that effort led to significant refinements in resource capability assessment techniques. Therefore, it is appropriate to apply any knowledge gained in Air Force research (when applicable to Navy problems) to produce a better product and to avoid duplication of efforts across the services. The OSD/MRA&L requires the capability to assimilate and utilize these methodologies in developing its own long-term logistics budgeting and capability plans for obtaining, integrating, and using information from the individual military services for logistics readiness evaluation.

The Overview Model, a part of the LCMS, was originally designed to provide the U.S. Air Force with tested and documented logistics readiness models that, on a quick-turnaround basis, illustrated the effects of various budgetary and management decisions on the immediate readiness, mission capability and sustainability of the United States Air Force. Over the past several years the Overview Model has undergone rigorous testing, evaluation, and improvement. The model has proved itself successful in assessing the logistics readiness, mission capability, and budget requirements of the Air Force. The Air Force work that is of particular interest is that portion which has developed methods of making wartime projections of spares capabilities by individual weapon systems under different assumptions and scenarios. While this has been done in detail and with credibility, the quick-response aspects of this system are critical to the present project. In addition, the Air Force has developed methods of balancing capabilities of, and requirements for, multiple individual logistics programs for various time periods in the future.

It is recognized however, that the Navy is not the Air Force and many significant differences exist. For example, the Navy has different missions, different resupply concepts, and different data systems, to name a few.

The first step in adapting these methodologies for Navy use is to develop working hypotheses about the relationships between its materiel readiness for reparable spares to capabilities for individual aviation weapon systems for the Navy. Specific examples were developed for individual aircraft weapon systems using the modified LCMS Overview Model and using data as provided by Navy Personnel.

In addition, emphasis on specific needs of the Navy that differ from those of the Air Force should be given prominence. The intent of this project was to demonstrate to the Navy that these methods are technically feasible and that the Navy should adopt the models developed under this project for their own use. Specifically, developing acceptable scenarios for carrier-based activities was given special attention. Problems of developing Navy-wide capability estimates by individual carrier groups, have been isolated and addressed with the development of feasible computation methodologies.

Synergy has developed a working computer model prototype of a chart relating Navy-wide sorties assigned under either Navy-provided scenario data or under both high and low-boundary scenarios to individual weapon system reparable spares capabilities for the F-14 weapon system used by the Navy. This model was adapted from the LCMS Overview Model used by the Air Force.

The second part of this effort was the development of a prototype model for air-to-air munitions.

Munitions sustainability and the depiction of alternatives for POM support has long been a problem area for the services. Heretofore, sustainability questions from OSD to the services have been answered, of necessity, with gross tonnages and dollars. While this kind of approach has been acceptable in the past, the information requirements for more sophisticated analyses and outputs in the area of munitions are increasing.

Synergy developed a working computer model prototype which relates requirements, time-phased for each individual munition to current and projected inventories on an individual munition-type basis. The model is sensitive to changes in key variables such as expenditure per sortie factors (EPSF), weapon loads, role effect factors, and shifts in scenarios. In addition, the model is capable of handling substitution of less preferred munitions for preferred munitions when they are exhausted.

The spares model that was developed is currently in use. The munitions model is still a manual prototype. A detailed description of each is contained in the following sections.

III. CAPLOG SPARES MODEL

A. Introduction

During the first six months of this contract, Synergy, Inc. has adopted U.S. Air Force logistics capability assessment methodologies for use by the U.S. Navy. Initially, this work has focused upon projections of wartime spares capabilities for individual weapon systems under different assumptions and scenarios to analyze the capability and sustainability of the U.S. Navy.

Our work in this area has led to the development of a Navy aviation spares capability assessment model and management information system known as the CAPLOG system. The CAPLOG system is designed to assess, on a quick-response basis, the effects of various budgetary and management decisions on the immediate readiness, mission capability and sustainability of the U.S. Navy.

The CAPLOG system by design consists of four modules which, when used together, will give a complete picture of the current logistic readiness and budgetary needs of the Navy's aviation reparable spares programs. The system is designed in a modular fashion and our prototype development has proceeded in a modular fashion. The Navy and Synergy jointly decided to start the building of the CAPLOG system with the development of the Mission Degradation Module.

Mission Degradation was chosen for the initial prototype development because it will provide the capability the Navy needs first; i.e., the assessment of mission capability and sustainability by weapon system. This report presents interim results of this prototype development.

This section begins with a description of the CAPLOG system. This is followed by a description of the data base, including problems encountered, and how the data base was expanded, and the flying hour inputs. Next is a brief description of the model conversion, process, procedures for accessing the system, and a SOURCE Listing. The last pieces in this section are a description of output reports, model results, and a description of model runs using the new data base, including a briefing on these results.

B. Description of the CAPLOG System

The CAPLOG system was designed to ultimately include four different modules which, when used together, would portray the current logistics readiness and budgeting needs of Navy aviation reparable spares programs. These modules are:

1. The Mission Degradation module provides an analysis of mission capability and sustainability by weapon system and indicates specific spares that cause mission failure or degradation. The module calculates on a day-by-day basis the percentage of required missions flown based on availability of spare parts.

2. The Shortfall/Buy module assesses mission sustainability as it relates to aviation logistics budgets and spares management decisions. The module determines the total reparable spares budget required to support a given flying hour program for both peace and war.

3. The Pipeline Fill module calculates for each day of a war the dollar value of all reparable spares that have failed and are in some phase of the repair process. The module calculates the dollar value of the inventory necessary to compensate for spare parts in the repair pipeline due to a specified fluctuating wartime flying hour program.

4. The Readiness Module measures the state of logistics readiness as a function of spare-part availability. The module determines the number of times during the war that specific spares cause a NMCS aircraft to occur and lists those NSNs which are in a short or a long supply position.

All four modules will use data from the same sources. The mathematical methods employed in each of the modules are consistent with each other so that a complete picture of Navy logistics readiness and budgets can be obtained.

The development of the CAPLOG system is proceeding in a modular fashion. Therefore, initial development as described in this document focuses on the Mission Degradation Module and the data base which supports it and the other modules. The Mission Degradation Module provides the capability that the Navy requires first, which is the assessment of mission capability and sustainability by weapon system. The data base development is critical and represents a large part of the effort since the data must be extracted from a number of Navy data systems.

C. The Mission Degradation Module

The purpose of the Mission Degradation Module is to evaluate the relationship between reparable spare inventory investments and Navy mission capabilities. It calculates the time to exhaustion of all spare parts (NSNs) for selected aircraft. It calculates the number of aircraft available for mission assignments and the number of assembled aircraft as a function of reparable spare inventories and repair cycle times.

For each spare, demands, condemnations and repairs are calculated. The repaired parts are added back into the ready-for-issue category. When an aircraft requires a ready-for-issue spare and one is not available (the inventory has been exhausted), the first source of spares, as described below, is from cannibalization. The program currently uses the default assumption that the TMSs specified are served in an established priority order. The program, thus, runs every TMS every day from a pool of both common and unique spares assumed to be available to all aircraft on an as-needed basis, but in TMS priority order. (This logic feature is not relevant in the initial prototype because only one TMS, the F-14A, is being used.

While the model is running, a continuous inventory account is maintained for each spare part. Those spares that fail on a given day are withdrawn from the running inventory and those that are repaired and returned to a serviceable state are added to inventory by day.

The sequential logic used by the Mission Degradation Module is as follows:

First, for the selected aircraft used in the simulation, the peace and war flying hour programs and the sensitivity parameters are defined. As the model starts the simulation, processing each spare part, it establishes several initial conditions or assumptions:

(1) The Navy can perform its mission with some aircraft in a non-operative status, which are then cannibalized to provide spare parts to essential aircraft. The default assumption of this model is to assume that when a ready-for-issue spare part is needed and is not available, an aircraft is immediately, completely, and costlessly cannibalized. Thus, every assembled aircraft is thought of as consisting of a large number of assembled spare parts. The "quantity per aircraft" (QPA) and the "application percentage" are used to accomplish this result.

(2) At present status, the module considers 365 peace days and up to a 120-day war.

(3) Aircraft attrition and down-time are determined by aircraft type, but not as a function of time. Attrition is subtracted from all assembled aircraft. To meet its mission requirement, the module tries to use all of these assembled aircraft while minimizing the average missions per aircraft per day.

(4) The number of missions per TMS based on "flying hours per day" and "hours per mission" cannot be greater than the upper limit based on the ratio of a 24-hour day (less down-time) to "hours per mission." In other words, an upper limit of the maximum number of missions/day per aircraft is imposed; flyable aircraft try to meet the flying program by increasing the number of missions per aircraft per day up to the established maximum.

Serviceable Total Assets for peace and wartime are defined as on-the-shelf and ready-for-issue items. Unserviceable assets are distributed uniformly across the repair pipeline and On-Order Assets are distributed uniformly across the procurement pipeline. This creates the Initial Inventory.

The total number of parts per NSN that are installed in each TMS (QPA--quantity per application) is multiplied by the number of aircraft in that TMS in the force mix. This represents the "Total Number of Parts Installed" in the assembled aircraft. The "Initial Inventory" is then added to the "Total Number of Parts Installed" to establish the initial "Parts on Hand" for wartime simulation. Added to "Parts on Hand" are the daily additions of "Base and Depot Returns" creating the "Total Parts" available for assembling aircraft. This is done for each day of the simulated war.

Before processing all the TMSs, "Available Aircraft" is initialized by dividing "Total Parts" by the QPA (number of spares) associated with that TMS. Note that the Quantitites per Application (QPA) for each NSN can be unique or common. When common are used by more than one aircraft, the QPA order is the same as in the TMS's cross-reference dictionary. The QPA for any TMS is between one and ninety-nine.

Therefore, for each NSN record processed, all TMSs are checked to see if they use or need the part during the war. If "Available Aircraft" is greater than "Assembled Aircraft" (assembled aircraft minus attrition), it is set equal to "Assembled Aircraft"; if negative, it is set to zero. Eventually "Total Parts" becomes the number of aircraft remaining from those which were in the inventory on D-day after subtracting those lost by attrition or inoperable because of a needed part or parts.

As the number of "Available Aircraft" is defined according to remaining available parts, also calculated are "Aircraft Lost by Attrition" and "Missions Flown per Aircraft." In other words, when one spare fails and there are no serviceable assets in the inventory for it, that aircraft is then cannibalized and the remaining flyable aircraft have to try to perform all of the missions without it. However, all of the spares on that cannibalized aircraft are assumed to be available in serviceable inventory for remaining flyable aircraft.

The force is assumed to complete 100 percent of its missions for as long as possible. As soon as the number of flyable aircraft (each operating at the maximum number of sorties per day) cannot meet all assigned missions, mission degradation begins to occur. As additional flyable aircraft are short of essential spares which are not available and have to be cannibalized, the percentage of missions tends to decline. On the other hand, when serviceable spares begin to return from bases and depots, NMCS, or cannibalized aircraft are assumed to be repaired or reassembled.

Finally, at the end of the wartime simulation, the following are calculated:

(1) "Cannibalized Aircraft" by subtracting "Available Aircraft" from "Assembled Aircraft."

(2) "Missions per Aircraft" by dividing the number of "Aircraft Missions Required" (from Flying Program) by "Available Aircraft."

(3) "Percent Missions Flown" the ratio of "Missions Flown" (mission by "Available Aircraft") to the number of "Aircraft Missions Required."

For each year's simulation, the percent degradation of missions (missions not flown) caused by inadequate inventory of reparable spare parts at the commencement of a war is determined.

D. The CAPLOG Data Base

This section presents a report on the development of the CAPLOG data base. Quantitative models such as Mission Degradation are sensitive to the quality of data. The best available sources of Navy aviation data have been identified to insure that the results of the Mission Degradation Module are as realistic and accurate as possible.

The CAPLOG system requires specific detailed information on each reparable spare contained in the data base. This detailed information on each item is needed to support the basic capabilities and requirements assessment algorithms. Immediately following is a description of the CAPLOG item-specific data base.

THE ITEM-SPECIFIC DATA BASE

Variable #	Variable Name	Units	Definition
1	National Stock Number		National Stock Number
2	Unit Price	Dollars	The unit price of an item
3	Administrative Lead Time	Months	The administrative lead time is the time between preparing a contract/purchase order and the date of its award or order initiation.
4	Production Lead Time	Months	The period in time between planning an order or letting a contract and the date of receipt of the first production
5	Base Order and Ship Time	Days	Total number of calendar days that elapse between the initiation of a request for a serviceable item from the base and its receipt

Variable #	Variable Name	Units	Definition
6	Demand	Failures/ Million Flying Hours	The number of failures at bases for replacement of removed unserviceable spare parts per million flying hours
7	BCM %	Percent	The percentage of base failures that must return for processing at the depot
8	Base Repair Cycle Days	Days	Total number of calendar days between the time an unserviceable item is removed from use and the time it is made serviceable in base maintenance and ready for use
9	Depot Repair Cycle Days	Days	Total number of repair days between the time an unserviceable item is removed from use and the time it is made serviceable from depot maintenance and ready for use
10	BCMs Condemned	Percent	The portion of base-processed units that were beyond economical repair, therefore condemned
11	Depot Condemnation Percent	Percent	The portion of depot processed units that were beyond economical repair, therefore condemned
12	Item Essentiality Code	1-5	A numeric code assigned to an individual item indicating its relative impact, on mission capability in the event of a stockout. The code is a ranking factor numbered one (least impact) through five (greatest impact)
13	Unit Repair Cost	Dollars	Repair cost of a spare part
14	On-order Assets	Number of Items	The model is programmed to accept nineteen categories of on-order assets.

Variable #	Variable Name	Units	Definition
15	Total Assets	Number of Items	The model is programmed to accept a total of fifteen categories of total assets which include serviceable plus unserviceable and on-order assets
16	QPA	Number of Items	Quantity Per Application
17	Application Percent	Percent	The percent of a particular TMS that has this particular part on it

Three major organization sources of Navy Aviation data have been identified: the Master Data File from the Navy Aviation Supply Office (ASO), the 3M data base from the Navy Aviation Maintenance Support Office (NAMSO), and the Master Component Rework Control System (MCRC) data base from NALC. Immediately following is a brief description of the different sources of data.

1. ASO Data

The ASO data are stored in an integrated multiple file complex. The ASO files of interest to this project include the Master Data File (MDF) which contains a large number of variables by stock number plus the Weapon System File (WSF) which contains a "top-down" breakdown of each aircraft/weapon system/equipment in the ASO inventory. It provides the capability to identify each part component, system, or subsystem to its higher or next lower application(s). The WSF is structured into levels which provide the capability to identify each item used on each aircraft common to different aircraft and, conversely, the various aircraft utilizing a particular item.

The F-14 weapon system data were sent from ASO on three magnetic tapes including one for the MDF and two for the WSF. The MDF tape (E48RT1) contains approximately 80 data elements on six record types for each of the approximately 4,000 items in the file. Exhibit 1 is a list of the data elements that are available of E48RT1.

The WSF tapes (E48BU2 and E48BU2A) contain three types of records and approximately seven unique variables. Exhibit 2 is the record layout for the MDF and Exhibit 3 is the WSF record layout. Each data element has been assigned a specific location on a specific record. Each record can contain up to 130 characters.

EXHIBIT 1
ASO DATA ELEMENTS

E48RT1

3/11/81

DEN	TITLE (RECORD)
B001	Nonautomatic Action Code (2)
B002	Local Routing Code (1)
B010	Contract Production Lead Time Average (3)
B011A	Contract Production Lead Time Forecast (3)
B012	Navy Non Reporting and Commercial Repair TAT Average (3)
B012C	NAVY Reporting Repair in Process Time Average (3)
B022	System Recurring Demand Average (3)
B022A	System Recurring Overhead Demand Average (3)
B053	Unit Price (1)
B055	Unit Price Item Replacement (2)
B067A	Newly Provisioned Item Indicator (2)
B067E	Program Related for Future Demand Indicator (2)
B067F	Reparable Item Indicator (2)
B067H	Navy Reporting Activity Repairable Indicator (2)
B067J	Program Related for Current Demand Indicator (2)
B074	Quarterly System Demand Forecast (3)
B098	Estimated Maintenance Demand Forecast (3)
B098A	Estimated Overhead Demand Forecast (3)
C001A	Family/Group Code (2)
C001B	Family Relationship Code (2)
C002B	Activity Control Number/Permanent System Control Number (All)
C003	Cognizance Symbol (1)
C003A	Material Control Code (1)
C003B	Special Material Identification Code (1)
C004	Item Name (2)
C005	Unit of Issue (2)
C007	Minimum Repalcement Unit Quantity (6)
C007A	Allowance Override Quantity (6)
C007B	Allownace Override Designator Code (6)
C008E	Military Essentiality Code - Part to Component (6)
C012	Entry Date - Julian (1)
C017	Security Classification Code (2)
C028	Shelf Life Code (2)
C029	Shelf Life Action Code (2)
C035	Federal Supply Code for Manufactures/Non-manufacture (5)
C036	Procurement Number Code (2)
C042	Federal Supply Classification (1)
C043	Automatic Purchase Expiration Date (3)
D001	Reference Number (5)
D002	Reference Data Suppression Code (5)
D005	Next Higher Assembly Number (6)
D006	Variation Code (5)
D008	Separable Identification Code (1)
D009	Application Code (6)
D011	Quantity per Application (6)
D012	Source Code (2)
D012A	Supplemental Source Code (2)
D013	Maintenance Code (6)
D013B	Recoverability Code (2)

DEN	TITLE (RECORD)
D016	Alternate Federal Item Identification Number (4)
D016A	Alternate FIIN Relationship Code (4)
D017	Demilitarization Code (2)
D024	Reference Number Category Code (5)
D025E	Procurement Method Code (3)
D025F	Procurement Method Suffix Code (3)
D027	Type of Number Code (3)
D029	Application/Identification Number Activity Code (1)(6)
D030	Special Supplimentary Nomenclature (6)
D046D	National Item Identification Number (All)
D090	Reference Number Format Code (5)
D093	Manager MOE Rule Number (5)
D094	Multi-Manager MOE Rule/Item Status Code (5)
D095	User MOE Rule Number (5)
D096	Supplemental II Data Collaborators (5)
D097	Supplemental II Data Receivers (5)
D120	Level of Authority - PICA/SICA (2)
D125A	Army Nonconsumable Item Material Support Code (2)
D125B	Air Force Nonconsumable Item Material Support Code (2)
D125C	Marine Corps Nonconsumable Item Material Support Code (2)
D125N	Navy Nonconsumable Item Material Support Code (2)
E006	Allowance Note Code (6)
E007	Allownace Equipage List Quantity (6)
E106	Best Replacement Factor Derivation Code (3)
F001	Maintenence Replacement Rate Organizational Level (6)
F001A	Maintenance Replacement Rate, Intermediate Level (6)
F003	Overhaul Replacement Rate (6)
F007	Wearout Rate (3)
F008A	Service Life Code (2)
F008B	Service Life Action Code (2)
F009	Repair Survival Rate (3)
F010E	Progressive Rework Turn Around Time, East Coast (6)
F010W	Progressive Rework Turn Around Time, West Coast (6)
F011E	Progressive Rework Allowed Off Time, East Coast (6)
F011W	Progressive Rework Allowed Off Time, West Coast (6)
F015	Concurrent Rework Code (5)
F016	Designated Overhaul Point (3)
F018	Percent Per Application (6)
F024A	Non Automated Purchase Referral Code (3)
F024B	Non Automated Technical Referral Code (3)
F027	Best Replacement Factor (3)
. . .	File Indicator (1)
. . .	Sequence Code (All)
. . .	Record Line Code (All)

EXHIBIT 2

RECORD FORMAT FOR MDF

E48RTI   1 of 3

ITEM LAYOUT

FILE NO.	FILE NAME	DESIGNED BY:	RCD SIZE CHARACTERS /F V	RCDS PER BLOCK /F V	SEQUENCE	LABEL - TRAILER - DENSITY - PADDING
E48RT1	MDF/PSI RECORDS For General Review	FMSO	130/F	10/F		STANDARD UICP

LINE 1 DATA

CH POS	1-18	19-27	28	29	30-31	32-35	36-37	38-42	43-54	55-59	60-68	69	70-99	100	101-118	119-130
DATA	SEQUENCE CODE	D046/ C002B NIIN/ACN	BLANK	RCD LN CODE 1	C003 COG	C042 FSC	C003B SMIC	C012 EDJ	D008/ D029 RIC/ AINAC	B002 LRC	B053 U/P	C003A MCC	Blank	M=MDF P=PSI	BLANK	D008/ D029 MOD CODE /AINAC
PICTURE	X(18)	X(9)	X	X	XX	XXXX	XX	X(5)	X(12)	X(5)	9(7)V99	X	X(30)	X	X(18)	X(12)

LINE 2 DATA

CH POS	1-18	19-27	28	29	30-48	49-57	58-59	60	61	62	63	64-65	66	67	68	69
DATA	SEQUENCE CODE	D046D/ C002B NIIN/ ACN	BLANK	RCD LN CODE 2	C004 ITEM NAME	B055 UPIR	D012 SOURCE CODE	D012A SUPPL SOURCE CODE	D013C RECOV CODE	BLANK	C017 SCC	C005 UI	D017 DMIL	B067A NEW PROV ITM IND	B067E FUTURE DMD IND	B067F RPRBL ITM IND
PICTURE	X(18)	X(9)	X	X	X(9)	9(7)V99	XX	X	X	X	X	XX	X	X	X	X

CH POS	70	71	72-76	77	78-79	80-83	84-85	86-89	90	91-92	93	94	95	96	97-130
DATA	B067H NRA RPRBL IND	B067J CUR DMD IND	B001 NAC	C028 SHLF LF CODE	C029 SHLF LF ACTION CODE	F008A SRVC LF CODE	F008B SRVC LF ACTION CODE	C001A FAMILY GROUP CODE	C001B FAMILY RELNP CODE	D120 PICA/ SICA	D125A ARMY NIMSC	D125B AF NIMSC	D125C MARINE NIMSC	D125N NAVY NIMSC	BLANK
PICTURE	X	X	X(5)	X	XX	X(4)	XX	X(4)	X	XX	X	X	X	X	X(34)

LINE 3 DATA

CH POS	1-18	19-27	28	29	30-35	36	37-41	42	43-46	47	48-51	52	53-56	57	58-61
DATA	SEQUENCE CODE	D046D/ C002B NIIN/ACN	BLANK	RCD LN Code 3	F027 BRF	E106 BDCD	B074 QSDF	BLANK	B022 SRD AVG	BLANK	B098 EMD FRCST	BLANK	B022A SROD AVG	BLANK	B098A EOD FRCST
PICTURE	X(18)	X(9)	X	X	99V9(4)	X	9(5)	X	9V999	X	9V999	X	9V999	X	9V999

NAVSUP FMSO 5230/40

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ITEM LAYOUT

FILE NO.	FILE NAME	DESIGNED BY:	RCD SIZE CHARACTERS /F V	RCDS PER BLOCK /F V	SEQUENCE	LABEL · TRAILER · DENSITY · PADDING
E47RT1	MDF/PSI RECORDS for General Review	FMSO	130/F	10/F		STANDARD UICP

LINE 3 DATA CONT'D

CH POS	62-64	65-67	68-69	70-71	72-77	78-83	84-86	87-90	91-95	96	97	98	99	100-130
DATA	F009 ASR	F007 WR	B012C NRRPT AVG	B012 NNRC TAT AVG	F016 FIRST DOP	F016 SECOND DOP	B010 CPLTA	B011A CPLTF	C043 APXD	F024A NPRC	F024B NTRC	D025E PROC METH/ CODE	D025F PMSC	BLANK
PICTURE	9V99	9V99	9V9	9V9	X(6)	X(6)	99V9	99V99	X(5)	X	X	X	X	X(31)

LINE 4 DATA

CH POS	1-18	19-27	28	29	30-40		41-51		52-62		63-73		74-84		85-95		96-106		107-117		116-130
DATA	SEQUENCE CODE	D046D/ C002B NIIN/ACN	BLANK	RCD LN CODE 4	1ST ALT NIIN		2ND ALT NIIN		3RD ALT NIIN		4TH ALT NIIN		5TH ALT NIIN		6TH ALT NIIN		7TH ALT NIIN		8TH ALT NIIN		BLANK
					D16 AN	D16A ANRC	D16 AN	D16A ANRC	D16 AN	D16A ANRC	D16 AN	D16A ANRC	D16 AN	D16A ANRC	D16 AN	D16A ANRC	D16 AN	D16A ANRC	D16 AN	D16A ANRC	
PICTURE	X(18)	X(9)	X	X	X(9)	XX	X(9)	XX	X(9)	XX	X(9)	XX	X(9)	XX	X(9)	XX	X(9)	XX	X(9)	XX	X(13)

LINE 5 DATA

CH POS	1-18	19-27	28	29	30-34	35-66	67	68	69	70	71-72
DATA	SEQUENCE CODE	D046D/ C002B NIIN/ACN	BLANK	RCD LN CODE 5	C035 FSCM	D001 REF NR	D002 RDSC	D006 VARN CODE	D024 REF NR CAT CD	C038 PROC NR CODE	D027 TYPE NR CODE
PICTURE	X(18)	X(9)	X	X	X(5)	X(32)	X	X	X	X	XX

CH POS	73	74-76	77-80	81-88	89-92	93-95	96-98	99-130
DATA	D090 REF NR FORMAT CODE	BLANK	D093 N%OE RULE NR	D094 NMMRIS CODE	D095 USER POE RULE NR	D096 SIIDC	D097 SIIOR	BLANK
PICTURE	X	XXX	X(4)	X(8)	X(4)	XXX	XXX	X(32)

NOTE:
SEPARATE "5" RECORDS FOR TRL#1 (P/N) AND TRL"K" (USERS) — NO LIMIT TO EITHER. 4/23/81

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EXHIBIT 2 (Cont'd)

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ITEM LAYOUT

FILE NO.	FILE NAME	DESIGNED BY:	RCD SIZE CHARACTERS IF V	RCDS PER BLOCK IF V	SEQUENCE	LABEL-TRAILER-DENSITY-PADDING
E48RT1	MDF/PSI RCDS FOR G.R.	FMSO	130/F	10/F		STANDARD UICP

LINE 6 DATA

CH POS	1-18	19-27	28	29	30-39	40-41	42-43	44-48	49-51	52-55	56-59	60-62	63
DATA	SEQUENCE CODE	D046D/ C002B NIIN/ ACN	Blank	RECORD LINE CODE 6	D009 RIC	D029 AIMAC	D013 MAINT CODE	D011 QTY PER APPLIC	F018 PCT PER APPL	F001 MAINT RPL RT ORG LVL	F001A MAINT RPL RT INT LVL	F003 OVHL REPL RATE	E006 ALLOW NOTES CODE
PICTURE	X(18)	X(9)	X	X	X(10)	XX	XX	X(5)	999	9V999	9V999	9V99	X

LINE 6 DATA

CH POS	64-66	67-69	70	71	72-73	74-75	76-105	106-109	110-124	125-127	128	129-130
DATA	F010E PROG REW TURN-A-TIME EAST CST	F010W PROG REW TURN-A-TIME WEST CST	C008E MEC	F015 CURRENT REWORK CODE	F011E PROG REW ALL'D OFF T EAST CST	F011W PROG REW ALL'D OFF T WEST CST	D005/E007 NHA NBR/ ALL EQP LIST QTYS	C007 MIN REPL UNIT QTY	D030 SPECIAL SUPPLEMTY NOMEN	C007A ALLOW OVERRIDE QTY	C007B ALLOW OVERRIDE DESIGN CODE	Blank
PICTURE	XXX	XXX	X	X	XX	XX	X(30)	X(4)	X(15)	XXX	X	XX

CH POS	
DATA	
PICTURE	

CH POS	
DATA	
PICTURE	

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E48BU2
E48BU2A

EXHIBIT 3
RECORD FORMAT FOR WSF

ITEM LAYOUT

FILE NO.	FILE NAME	DESIGNED BY:	RCD SIZE CHARACTERS /F V	RCDS PER BLOCK /F V	SEQUENCE	LABEL - TRAILER - DENSITY - PADDING
E48BU2	CHAIN EXTRACT RECORDS	FMSO	110/F	10/F	RANDOM	SRANDARD UICP

IDENTIFIER EXTRACT RECORD

CH POS	1-2	3-20	21-30	31-32	33-46	47-52 53-80	81-96	97-101	102-110
DATA	ACCUMULATOR CODE	SEQUENCE CODE (NNN AND 15 BLANKS)	D008 MODEL CODE (KEY RIC)	D029 AINAC	b	REQUIREMENTS CODE: A B b b E b	REQUESTORS ID	ORGANIZATION CODE	b
PICTURE									

KEY RIC DATA RECORD (FATHER)

CH POS	102	3-20	21-30	31-32	33	34-37	38-46	47	48-95	96-101	102-110
DATA	ACCUMULATOR CODE	SEQUENCE CODE (NNN AND 15 AEROS)	D008 MODEL CODE (KEY RIC)	D029 AINAC (KEY RIC)	RECORD CODE "1"	b	D046D/C002B NIIN/ACN (FOR KEY RIC) OR b	C017 SECURITY CLASS CODE	E001 NOMEN	D011 QTY PER APPLIC	b
PICTURE											

L/A RIC DATA (SON THRU GG G' SON)

CH POS	1-2	3-20	21-30	31-32	33	34-37	38-46	47	48-95	96-101	102-110
DATA	ACCUMULATOR CODE	SEQUENCE CODE	D008 MODEL CODE (ACCESSED RIC)	D029. AINAC (ACCESSED RIC)	RECORD COBE "3"	b	D046D/C002B NIIN/ACN (ACCESS RIC) OR b	C017 SECURITY CLASS CODE	E001 NOMEN	D011 QTY PER APPLIC	b
PICTURE											

CH POS	
DATA	NOTE: E48BU2A IS SORTED BY NIIN (38-46) & DUPS ARE ELIMINATED
PICTURE	

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PROGRAM ID: E48BUAAA00
DATE: MAY 9 1978
ENCLOSURE: (5)

2. NAMSO Data

NAMSO's 3M data system will be the source for the retail-level item data. The 3M system contains two basic kinds of data necessary for the CAPLOG prototype. First, 3M represents a basic source for retail level failure rates. These data are reliability and maintainability observations by work unit code and major command. These are in the form of flying hour and failure observations which can be translated into demand rates by work unit code.

Ideally, it is preferable to have the demand rates by stock number. However, the Navy appears to keep failure data only on a work unit code basis. Usually, there will be several stock numbers included in any one work unit code. Therefore, to achieve a stock number level of detail, another piece of information from NAMSO will be used--the work unit code/part number/NIIN cross-reference. The implicit assumption is that any stock number within a work unit code experiences the same failure rate as the work unit code.

In addition to failure rates and a cross-reference dictionary, the NAMSO data include several item-level observations. On a stock number basis, turnaround times (repair cycle times) at the retail level, the returns to depot for repair, and the condemnations at the retail level are available.

The failure data are contained on tape MAXH94/DD1. The record layout for this tape is shown in Exhibit 4. The record layout of tape MAX93/CC1, the item-level data, is shown in Exhibit 5.

EXHIBIT 4
NAMSO TAPE FORMATS

RECORD LAYOUT
4ND-SPCC-10462/2 (REV. 10-83)

PLATE NO. 15030

PREPARED BY	DATE	PAGE	SEE REVERSE SIDE	TID NO.	REV.
N. WOODWARD	6/21/82	1 of 1		MAXH94/DD1	

DESCRIPTION SUMMARIZED FLEET RELIABILITY RECORDS

MAINTENANCE DATA

1-8	9-22	23-24	25-28	29-35	36-73	74	75-78	79-85	86-92	93-99	100-107	108-115	116-122	123-129	130
AMN	EXPANDED WUC	FI	TYPE EQPT	WUC	NOMEN CLATURE	b	AVG NO OPER ACFT	FLT HRS (1D)	MAINT ACTNS	TOTAL FAILURES	MAN HRS (1D)	EMT (1D)	ORG REPAIR FAILURES	BLANKS	≠
8	14	2	4	7	38	1	4	7	7	7	8	8	7	7	1

OPERATING ACFT AND FLIGHT HOUR DATA

1-8	9-22	23-24	25-74	75-78	79-85	86-129	130
AMN	BLANK	FI	BLANKS	AVG NO OPER ACFT	FLT HRS (1D)	BLANKS	≠
8	14	2	50	4	7	44	1

NOTE: Type Equipment Code (pos 25-28) is three positions, left justified.

CHARACTERISTICS

RECORD GROUPING	PADDING	RECORD LENGTH	VAR	FIXED	SPEED	TID ON TAPE
10	NONE	0130/1300		X	1600	UNLABELED

SEQUENCE (1) AMN (2) EXPANDED WUC (3) FI

OTHER

TID 40

EXHIBIT 5

RECORD LAYOUT
AMD-SPEC-1046822 (REV 10-67) (LOCAL)

PREPARED BY	DATE	PAGE	SEE REVERSE SIDE	FILE NO.	REV
N. WOODWARD	6/22/82	1 of 1		MAXH93/CC1	

DESCRIPTION: AIMD SUMMARY DATA

1-2	3	4-15	16-30	31-45	46-57	58-60	61-65
FI	RPT IND	VARIABLE DATA 12	15 PART NUMBER CLOSE-UP	15 PART NUMBER CLOSE-UP	VARIABLE DATA 12	BLANK	TOTAL ITEMS
		TE CAT 1 / ANN 8 / 3	EXP WUC 14 / 1	EXP WUC 14 / 1	TE CAT 1 / ANN 8 / 3		
		ORG CODE 3 / 9	NIIN 9 / 6	NIIN 9 / 6	ORG CODE 3 / 9		
2	1		WG 3 / 12	FUNCTION 15		3	5

66-85 ATC A/1			86-124 ATC B/C/K/2						125-136 ATC 1		137-155 ATC 4			156-172 ATC 2, 3/5-9			173-187 ML 1	
ITEMS	ML 2 HRS (1D)	ML 2 TAT	ITEMS	NBR AWP ITEMS	ML 2 HRS (1D)	ML 2 ENT (1D)	DAYS TAT	DAYS AWP	ITEMS	DAYS AWP	ITEMS	DAYS TAT	DAYS AWP	ATC 2 3/5-8 ITEMS	ATC 9 ITEMS	DAYS TAT	HRS (1D)	ENT (1D)
5	8	7	5	5	5	7	7	7	5	7	5	7	7	5	5	7	8	7

188-202	203-207	208-212	213-247	248-249	250-262 NSN		263-264	265	266-271	272-285	286-291	295	296-297	298-300	301-309 TEC		310-319
PART NUMBER (ORIG)	MFGR	WUC	WUC NOMEN	COG	FSC	NIIN	SMIC	NMDF	SMGR CODE	NIIN NOMEN	U/P (2D)	MCC	U/I	ORG	TE CAT	ANN	
15	5	5	35	2	4	9	2	1	6	14	11	1	2	3	1	8	10

CHARACTERISTICS

RECORD GROUPING	PADDING	RECORD LENGTH	VAR	FIXED	SPEC
10	NONE	320/3200		X	

SEQUENCE: RANDOM

OTHER

3. NALC Data

The Navy Air Logistics Center collects data on repair activities at the depot level. Most of the data reside in the Master Component Rework Control (MCRC) data base. Two variables were extracted from this data base--Average Depot Turnaround Time and Average Cost of Repair. These variables are by stock number.

4. Data Sources

This section documents the actual methodology used to construct the item-specific data elements using the various sources of Navy data. Exhibit 6 is a detailed list providing specific information on what the variable name is, what file this variable came from, its record location and, where necessary, how it was constructed.

5. Data Problems

There are several data problems which deserve mention. These problems fall into two general classes: manipulation of existing data to create a master data base and data which are needed, but which are not currently available.

First, several existing data elements were transformed to conform to the logic of the CAPLOG model. Minor examples include the merging of several data elements to develop a national stock number and the subtraction of production lead time from procurement lead time to develop administrative lead time. A major data manipulation involves the adjustment of item Quantity Per Application (QPA) and Application Percentages (AP) from the ASO Master Data File.

The model logic requires that all stock number QPAs and APs be at the weapon system level. That is, the model needs to know the total number of

EXHIBIT 6

DATA ELEMENTS

Var.Name	Start Position	Length	File Name	Record Type	Notes
Unit Price*	60	60-68	E48RT1(ASO)	1	
Contract* Production Lead Time Average	84	84-86	E48RT1(ASO)	3	Used to construct the administrative lead time
Contract Procurement* Lead time Forecast	87	87-90	E48RT1(ASO)	3	

* The Administrative Lead Time is constructed by subtracting the contract Production Lead Time average from the contract Procurement Lead Time forecast. Both of these variables are expressed.

Var.Name	Position	Length	File Name	Type	Notes
Repair Cost	49	49-57	E48RT1(ASO)	2	Used as a proxie for the repair cost from MCRC
Depot Condemation Percent	65	65-67	E48RT1(ASO)	3	This variable is known to ASO as the Wearout Rate
QPA	44	44-48	E48RT1(ASO)	6	
Percent per Application	49	49-51	E48RT1(ASO)	6	
Progressive Rework Turnaround Time (East Coast)	64	64-66	E48RT1(ASO)	6	Used to construct depot repair time*

* The depot repair time is constructed from the average of the Rework Turnaround Time (East Coast) and the Rework Turnaround Time (West Coast).

EXHIBIT 6 (Cont'd)

Var.Name	Position	Length	File Name	Type	Notes
Total Flight Hours	79	79-85	MAXH94/DD1 (NAMSO)	NA	Used to construct the demand rate
Total Failure	93	93-99	MAXH94/DD1 (NAMSO)	NA	Used to construct the demand rate

Var.Name	Position	Length	File Name	Type	Notes
Base Repair Time	111	111-111	MAXH93/CC1	NA	
Action Taken Code 1 CATC>	125	125-129	MAXH93/CC1	NA	

Var.Name	Position	Length	File Name	Type	Notes
ATC4	137	137-141	MAXH93/cc1	NA	Used to construct the NRTS rate*
ATC2-3-5-8	156	156-160	MAXH93/cc1	NA	
Total Items	61	61-65	MAXH93/cc1	NA	

* The base not reparable. This station (base NRTS %) is contructed by taking the sum of the action taken codes 1, 2, 3, 4, 5, 8 and dividing that sum by total number of items to get a percent.

Var.Name	Position	Length	File Name	Type	Notes
ATC 9	161	161-165	MAXH93/CC1		Used to construct Base Condemnation Percent

* Base Condemnation percent is constructed by dividing ATC 9 by the total number of items to get the percent of base condemnations.

each item on the weapon system. The information from ASO, however, is the QPA and AP for an item on its next higher assembly. If the item fits on another item before it fits on the aircraft, it is a lower-level item and the QPA could be underestimated and, therefore, demands underestimated.

This requires that application codes be extracted, levels of items be identified and their relationship to other items and to the weapon system defined. Then all QPAs and APs must be adjusted to the weapon system level.

The second major class of problems involves missing variables. There are problems with essentiality of items, total worldwide inventory of assets, and base order and ship times. Methods of working around each of these problems are discussed below.

The CAPLOG model allows for an essentiality code to be specified for each spare. This coding relates to mission essentiality and the model can be run on different classes of essentiality. The Navy does not currently have such a coding scheme; however, they are in the process of developing it.

Space has been left for this code in the data base and, when it becomes available, it can be utilized. In the interim, the model is run under the implicit assumption that all parts are equally essential. This will have the effect of underestimating true capability. This will be stated explicitly as a caveat to be considered in evaluating the results of the model.

The worldwide inventory problem requires a quite different approach. Worldwide inventory on a stock-number basis is available at the wholesale level. The problem is that these numbers will not include assets which are on the carriers. Therefore, some potential inventory numbers need to be created which help to bound the capability results.

Some estimates of total worldwide inventory have been created by working with the ASO data, carrier allowance lists, and some assumptions regarding the average fill rate on all carriers. The sum of products generated from the number in F-14 allowance list times the fill rate for each carrier will be added to the ASO inventory position for each stock number. This will provide a rough estimate of the inventory but will establish a boundary on the answer.

The Navy apparently does not collect data on average order and ship times for spare parts which are sent between carrier and depot. This is an important variable because it affects the quantity of a spare required to fill a pipeline and therefore the amount necessary to maintain a given capability.

In addition, the Navy situation is more complex than the Air Force situation with respect to this variable. The Air Force can be treated as one large base and one large depot with average order and ship times between the two. The Navy cannot be treated so simply, due to the mobility of its carriers.

The Navy has a maximum of thirteen carriers which move around the world to satisfy different perceived threats. Logistics lines in the Mediterranean will be shorter than logistics lines in the Pacific Ocean. Also, highly critical parts may be shipped by air, others may be shipped by surface ship.

This will be handled by setting up average order and ship time based upon scenario and therefore deployment location. The more remote the theater of engagement, the longer will be the average order and ship time.

Another way to handle this problem is to develop an average order and ship time for all carriers across all deployment locations and install this in the data base as an initial average. The model has the capability of increasing or decreasing a variable on a percentage basis for all parts. Therefore, this percentage could be used to increase or decrease the gross average order and ship time. For example, a Seventh Fleet engagement would require adjustment by a higher percentage than the Sixth Fleet.

These methods are appropriate for the first run of a prototypical planning model until better data or methods are available. A merged master data base was created of data elements by stock number. Exhibit 7 is a summary of sources of key data elements.

6. Initial Data Base

Dummy values were selected for the essentiality code and base order and ship time. The essentiality code was set to a value of one and the Base Order and Ship time was set to constant value of fifteen days.

To test the methodology used to construct the item specific data base, a small eleven item data base was built that was later expanded to 600 spares. Synergy analysts constructed the small data base by manually extracting each variable from the appropriate Navy files. Where necessary the needed data elements were constructed by using hand calculators. These computations were then checked against the values derived by the Navy computer to insure that the model is functioning properly.

7. Expansion of the Data Base

The approach selected for expansion of the F-14 analysis was to extend application of the prototype to all F-14 reparable spares for which data were available. Early in the effort, Synergy provided model runs based on approximately 900 reparable spare items for the F-14. These met project technical specifications but which were not sufficiently comprehensive or trustworthy for use in the CPAM process. Once the CPAM crisis time had passed, it was decided to pursue more detailed information on F-14 spares to expand coverage to as many as possible out of about 4000 items. Initial approaches for expanding consideration to additional items consisted of the following steps:

EXHIBIT 7

SOURCES OF KEY DATA ELEMENTS

Data Elements	Navy Sources
1. Master Stock Number	ASO
2. Unit Price	ASO
3. Administrative Lead Time	ASO
4. Production Lead Time	ASO
5. Base Order and Ship Time	Not Available
6. OFM Total Demand Rate	NAMSO
7. Base NRTS %	MAMSO
8. Base Repair Cycle	NAMSO
9. Depot Repair Cycle	NALC
10. Base Condemnation	NAMSO
11. Depot Overhaul Condemnation %	ASO
12. Item Essentiality Code	Not Available
13. Unit Repair Cost	NALC
14. On-order Assets	ASO
15. Total Assets	ASO
16. Quantity per Application	ASO
17. Percent per Application	ASO

a. Identify Specific Stock Numbers for Which Data is Missing

Synergy produced a list of specific National Item Indication Numbers (NIINs) for which data are missing. This project was headed by Mr. James Lutz, with programming support by Mr. Rudolfo Dela Garza.

b. Obtain Missing Data from Navy Maintenance Support Office (NAMSO)

A careful review was made of the stock numbers and data provided by Aviation Support Office (ASO). This was then matched up to NAMSO data. Most of the "holes" in the initial data obtained turned out to be an irreconcilable result of attempting to match NIINs to Work Unit Codes (WUC) to associate failure data (by WUC) with items (by NIIN). Mr. Lutz and Mr. Dela Garza visited NAMSO representatives Messrs. Manny Pierucci, Jim Kap, and Neil Woodward (717/790-2031) to obtain information on alternative approaches to data extraction.

Several fallback positions were developed to handle this, using other data sets.

c. Use AVCAL Data

There are about 350 items in the AVCAL rotable pool. An interesting exercise for its own sake and a fine fallback for this current analysis is to look at F-14 items in the AVCAL rotable pool. Data had already been obtained for about 50 of these items for the F-14.

Because a list of these items already existed, this would be used to focus immediate attention on these data if the research at NAMSO was not fruitful.

d. Use FSC Data

To the extent that WUCs could not be linked up with NIINs (or some other reasonable alternative approach) defaults could be developed by relating the NIINs to two-digit Federal Stock Class (FSC) using U.S. Air Force data that is easily attainable. This fallback was based on the assumption that it is better to have a reasonable estimate for every stock number than to have no data at all.

e. Use Other Available Data

Synergy planned to use every set of data obtainable and to use the CAPLOG Model ability to make many different runs quickly, to bound the problems on the F-14. Model runs had already been made using the available data for 909 items. When additional data were obtained, model runs could be made on that individual set of data to create nested sets of model runs. These model runs could then be used to draw conclusions and, most importantly, to look for convergence of results.

It was extremely important to the Navy that the results obtained for the F-14 had credibility. For the most part, the credibility required is supported by the quality of data on which all of the analyses is based. For the most part, this seems to be good quality data.

Regardless of the quality of the data, Synergy has amplified the basic model results with a number of different sets of specially scrubbed data in the procedures described above.

While these procedures would throw doubt on the model's credibility for some purposes, the convergence procedures, the data scrubbing procedures, and the particular uses of this model combine to give us rather high confidence in the results that have been produced.

First, the model has been used only to get aggregate current capability results. Specifically, the model has not been used for requirements determination or budgeting procedures. ASO uses tried and proven procedures in this area. The entire purpose was to get a baseline capability estimate which could be used to show the consequences of not properly funding ASO's independently determined requirements estimates.

In essence, the search was for the individual, and groups of individual spares that were likely to ground the aircraft. Fortunately, the Mission Degradation portions of the CAPLOG Model helped to isolate the top 25 spares which are causing these problems. Basically, this was a set of very critical spares that tend to ground the aircraft in wartime in a way that is slightly counter-intuitive, either by virtue of the fact that the spares are common to several aircraft or by virtue of the fact that the wartime demand characteristics and repair characteristics for the spares are quite different from those in peace.

Typically, in the Air Force (where this methodology was initiated) a small number of these spares somehow passes the collective intelligence of the *system*. *However*, *in* the environment of extreme funding shortfalls (that the Navy logisticians have experienced) people have to suboptimize allocation of their funds and their objectives tend to maximize the probability of accomplishing peacetime missions. When this occurs, then the model is credible if groups of spares tend to cause shortfalls at the same time.

Ultimately, the fallback positions were not exercised since the guidance received from NAMSO allowed for the production of an F-14 data base with 2,033 items, a significant increase over the earlier data base of only 909 items. Key to the procedures defined by NAMSO personnel was a method to derive demand data without going through a process for associating WUCs with NIINs. The NAMSO file manipulation is summarized in the flow chart in Exhibit 8.

In some cases, where multiple NIINs were associated with a WUC, it was necessary to compute an average failure rate using NAMSO variables as follows:

Other parameters necessary for the CAPLOG data base are:

1. Total Organizational and Intermediate Demand
   TOIMD = TMA - NRR

2. Base Repair Rate
   BRR = OIR/TOIMD

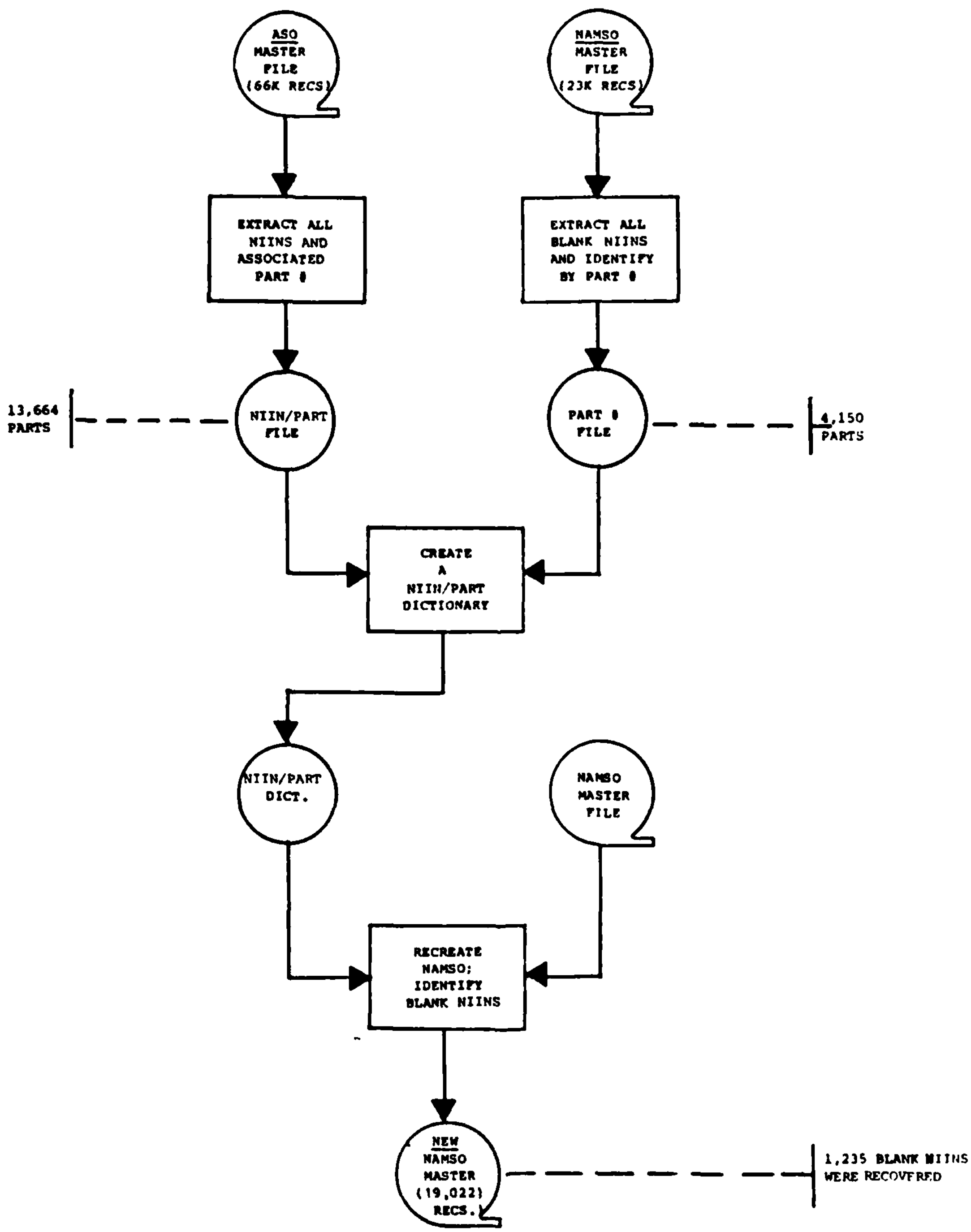
3. Base NRTS Rate
   NRTS = 100 (RNA + LOP + OAT)/TOIMD

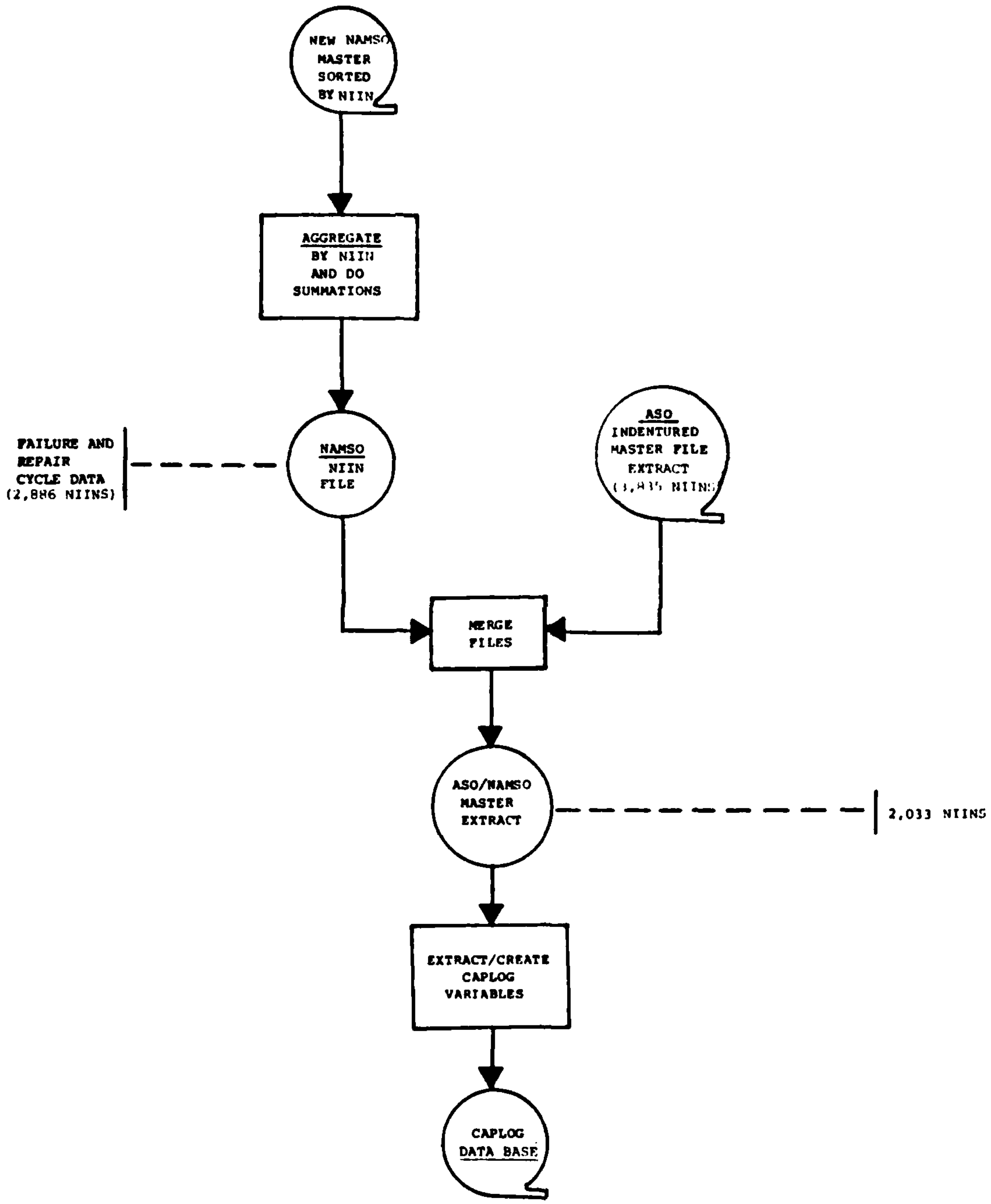
4. Condemnation Rate
   CNDR = CND/(CND + OIR)

5. Base Repair Time
   BRT = TAT/OIR

EXHIBIT 8

NAMSO FILE MANIPULATION
(FAILURE RATE AND REPAIR CYCLES)




NEW NAMSO MASTER SORTED BY NIIN
AGGREGATE BY NIIN AND DO SUMMATIONS
FAILURE AND REPAIR CYCLE DATA (2,886 NIINS)
NAMSO NIIN FILE
ASO INDENTURED MASTER FILE EXTRACT
MERGE FILES
ASO/NAMSO MASTER EXTRACT
2,033 NIINS
EXTRACT/CREATE CAPLOG VARIABLES
CAPLOG DATA BASE

NIINs	Hours	Removals	Total Fail[1]	NRR	Failures	FR (Average)	Notes
N_1	h_1	r_1	f_1	NR_1	fl_1	$f(N_1)=f_1/h_1$	Avg. FR = $\dfrac{\sum_{i=1}^{m} f_i/h_i}{m}$
N_2	h_2	r_2	f_2	NR_2	fl_2	$f(N_2)=f_2/h_2$	
N_3	h_3	r_3	f_3	NR_3	fl_3	$f(N_3)=f_3/h_3$	$= m^{-1}\sum_{i=1}^{m} h_i^{-1} f1$
.	.	.	.	.	.	.	
.	.	.	.	.	.	.	
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.	.	.	.	.	.	.	
.	.	.	.	.	.	.	
N_m	h_m	r_m	f_m	NR_m	fl_m	$f(N_m)=f_m/h_m$	Avg. FR = $m^{-1}h^{-1}\sum_{i=1}^{m} f_i$ iff: $h_i=h$ for each i

If total hours for F-14A are: $H = \sum_{i=1}^{m} h_i = mh_o$

Then an estimate of the average failure rate (FR) is:

$$FR = \sum_{i=1}^{m} f_i \cdot H \qquad \text{iff } h_i = h_o \text{ for each } i$$

[1]Total Fail = NRR + Failures where NRR - (no repair required) represe[illegible] a part removed and later determined operable (BRT).

The variables for failure data are taken from NAMSO data characterized by the record layout in Figure 2.

Where,

TMA = Total Maintenance Actions

NRR = No Repair Required

OIR = Organizational and Intermediate Repairs

TAT = (Base) Turn Around Time

RNA = Repair Not Authorized

LOP = Lack of Parts

CND = Condemnations

There are some slight differences in the repair cycle flow as characterized by the NAMSO data on one hand and the CAPLOG model on the other hand. These differences are not significant for purposes of the model results; however, the fundamental repair cycles are portrayed for comparison in Exhibit 9.

8. F-14 Data Base Listing

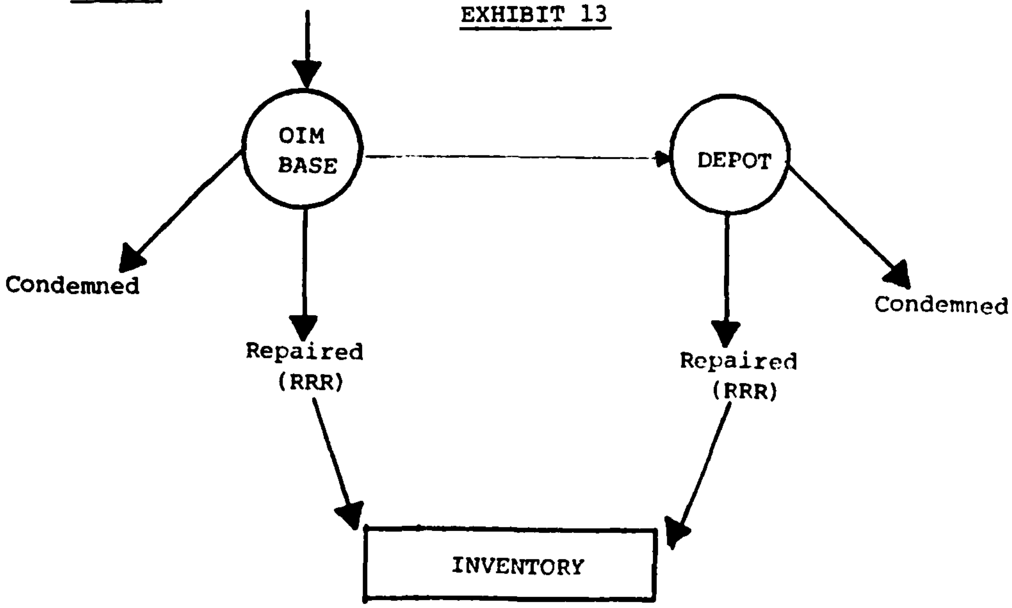
NAMSO verified that the 2,033 item data base was the best obtainable for the F-14. Furthermore, since the time span of the data covered one year of flying activity and since all item failures are recorded in the NAMSO data, it is safe to assume that items not in the data base had not failed over the course of a year and therefore missing items would be the no-failure items. This meant that all available means to expand data coverage on the F-14 had been tried, and that the data obtained could be assumed to be the most accurate and extensive available. A complete listing of the 2,033 item data base is available in other deliverables submitted under this contract.

EXHIBIT 9

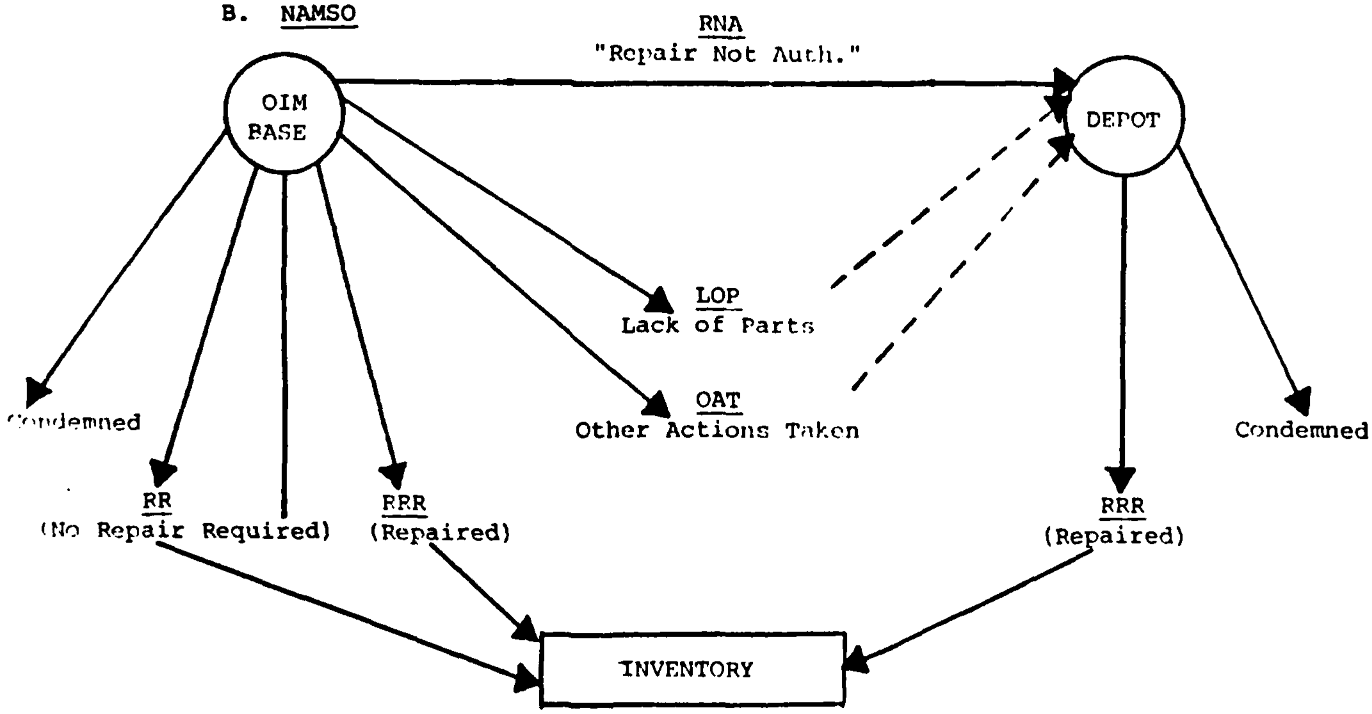
CAPLOG VS. NAMSO -- REPAIR CYCLE FLOW

A. CAPLOG

EXHIBIT 13



B. NAMSO



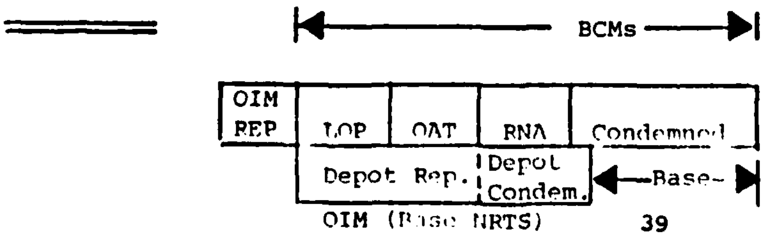


EXHIBIT 10

DATABASE DUMP --
SMALL PROTOTYPE

NERGY, INC. OVERVIEW MODEL MISSION DEGRADAT.. MODULE REPORT 15 PAGE 1
NY OVRVIEW TS DON ZIMMERMAN 8/06/82 UNCLASSIFIED

MASTER STOCK NUMBER	UNIT COST	UNIT REPAIR COST	ADMIN LEAD TIME	PROD LEAD TIME	BASE REPAIR TIME	DEPOT REPAIR TIME	ORDER + SHIP TIME	DEMAND RATE	BASE NRTS RATE	BASE COND. PCNT	DEPOT COND. PCNT	ITEM ESSEN. CODE	STOCK LEVEL	APPLICATIONS SYSTEM	APPLICATIONS AMOUNT
-520000011673	5260.00	2261.00	4	27	0	33	12	0.000077	1.00	0.	0.00	1	3	F014A	1
580000011751	381.00	163.00	4	13	0	52	19	0.000213	1.00	0\.	0.	1	1	F014A	
80000011752	728.00	313.00	5	14	13	38	31	0.000213	0.66	0.11	0.	1	17	F014A	1
40000014601	2370.00	1019.00	2	22	23	49	33	0.000012	0.33	0.	0.01	1	32	F014A	1
30000014611	2200.00	946.00	5	14	0	55	58	0.002053	1.00	0.	0.00	1	60	F014A	1
0000019572	1850.00	795.00	5	20	25	90	18	0.003213	0.50	0.	0.	1	1	F014A	1
.60000019574	168.00	72.00	5	14	12	60	21	0.002213	0.	0.	0.	1	0	F014A	1
80000019576	236.00	101.00	5	14	30	70	15	0.002213	0.	0.	0.	1	12	F014A	1
70000031558	2860.00	1229.00	5	11	47	41	25	0.00[illegible]034	0.18	0.	0.00	1	17	F014A	1
60000033732	599.00	257.00	3	12	19	43	57	0.000379	0.07	0.07	0.	1	3	F014A	1
80000049766PF	3990.00	1715.00	5	12	0	35	14	0.000012	0.50	0.30	0.00	1	20	F014A	1

.. OF 17
.NCTION?

E. Description of the Flying Hour Inputs

In addition to the item-specific data, all of the modules require TMS-specific flying programs over time for both peace and war. The flying hour program for each TMS is multiplied by the quantity of a given spare per application (QPA) and summed over all TMSs to get the total number of flying hours for that spare as a function of time. This spare part flying hour function is then multiplied by the appropriate demand rate to get the expected value demand function for each spare part. In addition to peace and wartime flying hour programs, the Mission Degradation Module requires information on attritions and aircraft down time in order to fully assess wartime capability and sustainability.

For this prototype development, flying hour parameters based upon the "Carrier Based Air Logistics (CABAL) Study" were used. The CABAL study was conducted by the Rand Corporation for the Navy. The purpose of this study was to estimate the workloads facing aircraft intermediate maintenance departments under various peace and war scenarios.

This study contains estimates of all the flying hour parameter needed to run the Mission Degradation with a model Navy flying hour program during this prototype phase. In the future, more accurate and updated flying hour programs will be needed in order to make the capability assessments as accurate as possible. Immediately following is a description of the CAPLOG flying hour files:

1. THE PEACETIME FLYING HOURS FILE

This file contains peacetime flying hours and inventories for all TMSs.

Variable #	Variable Name	Units	Definition
1	Type/Model/ Series (TMS)	NA	Aircraft mission design/ series, e.g., F-14A
2	Fleet Flying Hours/Day	Hours/Day	The total fleet flying hours per day for each TMS
3	Total Aircraft Inventory	Numbers of Aircraft	Total fleet inventory for nine years for each TMS

2. THE WARTIME FLYING HOURS FILE

This file contains average wartime flying hours per day per aircraft and the percentage of aircraft during a certain time period for all user-specified TMSs.

Variable #	Variable Name	Units	Definition
1	Type/Model/ Series (TMS)		Aircraft Type Model Series, e.g., F-14A
2	Wartime Flying Hours	Flying hours/day	Average wartime flying hours per day
3	Percent of Aircraft Available	Percent	Percentages of aircraft available during wartime periods, specifically:

period 1	days 1-5
period 2	days 6-10
period 3	days 11-15
period 4	days 16-30
period 5	days 31-60
period 6	days 61-90
period 7	days 91-120
period 8	days 121-150
period 9	days 151-180

EXHIBIT 11

FLYING PROGRAM SUMMARY

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 6 PAGE 7
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FLYING PROGRAM FOR 1981:

		PEACETIME FLY HRS/DAY		WARTIME FLY HRS/DAY															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		EACH	WHOLE	EACH	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
MDS	#ACFT	ACFT	FLEET	ACFT	31-45	46-60	61-90	-120	-150	-180									
F014A	259	0.84	217	4.00	518	518	518	518	518	518	518	518	518	518	777	777	777	777	777
					622	622	622	622	622	622	622	622	622	622	622	622	622	622	622
					[illegible]	[illegible]	922	829	725	829									

3. THE MENU FILE

This file contains the user's specified TYPE/MISSION/SERIES for a particular run of the model.

Variable #	Variable Name	Units	Definition
1	Type/Mission/ Series		Aircraft mission design series

MDSXREF

This file contains the standard MDS dictionary.

Variable #	Variable Name	Units	Definition
1	Type/Mission/ Series		Aircraft mission design series, e.g., F-14A

4. THE ATTRITION RATE FILE

This file contains attrition rates, down time, and sorties length by TMSs. The Attrition Rate File is unique to the Mission Degradation Module

Variable #	Variable Name	Units	Definition
1	Type/Mission/ Series (TMS)		Aircraft mission design series
2	Attrition Rate	Attrition /Sortie	The number of aircraft lost per sortie
3	Down Time	Hours/Day	The number of hours per day an aircraft is assumed grounded
4	Sortie Length	Hours/ Sortie	Hours per mission

5. THE CUMULATIVE ATTRITION FILE

This file contains cumulative attritions by TMS for ninety days.

Variable #	Variable Name	Units	Definition
1	Type/Mission/ Series		Aircraft mission design series, e.g., F-14A
2	Attrition/Day		The number of grand cumulative attrition that were lost by attrition during a specified period

6. THE ITEM-SPECIFIC DATA BASE

Variable #	Variable Name	Units	Definition
1	National Stock Number		National Stock Number
2	Unit Price	Dollars	The unit price of an item
3	Administrative Lead Time	Months	The administrative lead time is the time between preparing a contract/purchase order and the date of its award or order initiation.
4	Production Lead Time	Months	The period in time between planning an order or letting a contract and the date of receipt of the first production
5	Base Order and Ship Time	Days	Total number of calendar days that elapse between the initiation of a request for a serviceable item from the base and its receipt
6	Demand	Failures/ Million Flying Hours	The number of failures at bases for replacement of removed unserviceable spare parts per million flying hours
7	BCM %	Percent	The percentage of base failures that must return for processing at the depot

Variable #	Variable Name	Units	Definition
8	Base Repair Cycle Days	Days	Total number of calendar days between the time an unserviceable item is removed from use and the time it is made serviceable in base maintenance and ready for use
9	Depot Repair Cycle Days	Days	Total number of repair days between the time an unserviceable item is removed from use and the time it is made serviceable from depot maintenance and ready for use
10	BCMs Condemned	Percent	The portion of base-processed units that were beyond economical repair, therefore condemned
11	Depot Condemnation Percent	Percent	The portion of depot processed units that were beyond economical repair, therefore condemned
12	Item Essentiality Code	1-5	A numeric code assigned to an individual item indicating its relative impact, on mission capability in the eent of a stockout. The code is a ranking factor numbered on (least impact) through five (greatest impact)
13	Unit Repair Cost	Dollars	Repair cost of a spare part
14	On-order Assets	Number of Items	The model is programmed to accept nineteen categories of on-order assets.
15	Total Assets	Number of Items	The model is programmed to accept a total of fifteen categories of total assets which include serviceable plus unserviceable and on-order assets
16	QPA	Number of Items	Quantity Per Application
17	Application Percent	Percent	The percent of a particular TMS that has this particular part on it

F. Model Conversion

1. Disk to Tape

Copying the Overview Model from its resident computer system to a magnetic tape involved approximately 35 separate modules (5,300 card image records).

Two separate data files were also copied to tape, a large "test" data file containing all data necessary to run the model and an F-14A ten-spare "real" data file. Included with these files was a pre-processor FORTRAN program which creates a special compressed input data base.

2. Transferring

After contacting the tape librarian in Macon, Georgia and System Support in Atlanta, the tape was sent via Federal Express and loaded on Synergy's RAMUS II system library.

3. Conversion-Compilation

This involved converting the model from BCD (six bytes) to ASCII (four bytes) word configuration.

All arrays, matrices, and formats had to be converted to allow for the different word configuration.

Differences in FORTRAN involved re-writing routines.

4. Conversion-Debugging/Verification

After the model compiled successfully, the second phase in the conversion involved debugging and verification.

The preprocessor was used to compress and re-create the required input data base and several output reports were compared against the original reports produced by the model before conversion.

5. Conversion -- Job Control Language

Differences in JCL caused a considerable amount of reconstruction and testing. Manuals were ordered from Honeywell to define the Honeywell RAMUS II system environment.

6. Problems Encountered

Synergy did not encounter significant system-related problems. The able assistance of the System Support staff (especially Mr. David Robles) was especially helpful.

However, not having a high-speed printer for computer listings and printout reports did slow the conversion process. According to System Support in Atlanta, there is not one RJE (Remote Job Entry) station in the Washington metropolitan area hooked up to RAMUS II.

G. Procedures For Accessing The Model

1. Logging-on to RAMUS II Computer System

a. Phone: 634-6500 (300 baud)

634-6510 (1200 baud)

b. User Information:

User ID - 1700DCD231

Password - RYNXCS

Account No. - 409783

2. Input Run Parameters File - (Runout)

° The RUNOUT file contains eight segments or subfiles (see Attachment 1).

a. Sensitivity Analysis Parameters

b. Optional Report Selection

c. Scenario Decisions

d. TMS Selection

e. FSC Selection

f. ALC Selection

g. MSN Selection

h. Flying Hour Programs per TMS

° To change any parameter or record within a subfile, use the TSS (Time Sharing System) editor.

ex. Change the "Base Repair Time %" from 100% to 50%:

```
* EDIT OLD 1700DCD231/RUNOUT

- FVS:/BASE REPAIR TIME/

(Line will be printed here.)

- RVS:/100/:/Ø50/
```

(New line will be printed here.)

- RESAVE 1700DCD231/RUNOUT

- DONE

*

3. <u>Running the Model</u>

```
* CARD OLD 1700DCD231/BATCHDEG (See Attachment 2.)

* JRN

  SNUMB XXXXA                 (Job #)

* JSTS  XXXXA                 (Job status:)

  XXXXA -02 EXECUTING         (Job is executing)

* JSTS  XXXXA                 (Job status:)

  XXXXA OUTPUT WAITING        (Job has finished execution)

*
```

4. <u>Listing the Output Reports</u>

```
* JOUT  XXXXA                 (Transfers output to work buffer)

  FUNCTION? LIST              (Lists all report types:)

  $$                          (System listing)

  74                          (Source listing)

  06                          (Automatic Report 6)

  13                          (Optional Report 11)

  14                          (Optional Report 12)

  15                          (Optional Report 13)

  16                          (Optional Report 14)
```

17	(Optional Report 15)
18	(Optional Report 16)
19	(Optional Report 17)
* EPRINT XX	(Prints desired report)
	(Where XX = $$ through 19)

5. <u>Logging Off</u>

   * BYE

H. Output Reports

1. Purpose

The purpose of the Mission Degradation Module is to evaluate the relationship between reparable spare inventory investments and Navy mission capabilities. It calculates the time to exhaustion of all spare parts (NIINs) for each selected aircraft. It calculates the number of aircraft available for mission assignments and the number of assembled aircraft as a function of time. The module provides an analysis of mission sustainability by type/mission/series (TMS) and produces reports which track the extent of mission degradation due to a shortfall of spare parts.

The Mission Degradation Module can be thought of as a reproduction of a real world Navy logistics resupply system. This real world system is complicated and can only be handled by a means of simplified representation or model. This representation is symbolized in the algorithms and assumptions that comprise the model.

2. Assumptions

The following is a list of the principal explicit and implicit default assumptions used in making the Mission Degradation Module runs:

a. The data received from the various Navy sources is accurate,

b. Low aircraft attrition;

c. Peacetime flying hour programs continue at historical levels;

d. Every spare is assumed to be equally essential (therefore, the model may underestimate capability in some mission situations);

e. All on-hand assets are combined and available;

f. The F-14 draws from the same pool of common spares that other aircraft do (therefore, it may overestimate capability);

g. No spares are given to allies;

h. No attrition or loss of spares at bases or depots or in transit;

i. Repair times remain at peacetime levels despite increased wartime workloads;

j. No spare transportation or distribution problems;

k. Unserviceable assets have not been repaired at the start of the war,

l. The Navy can perform its missions with some aircraft in a non-operative status; they are then cannibalized to provide spare parts to essential aircraft;

m. All spares in wholesale and retail systems are assumed to get to the right plane on the right day.

3. Caveats

The model's best estimates provide useful working hypotheses until other evidence is developed. Sensitivity analyses are also needed to show the likely effects of changes in assumptions and of changes in Navy actions.

4. Model Outputs

The Mission Degradation Module produces a number of analytic reports that, when taken together, present a comprehensive analysis of Navy mission capability and sustainability based on reparable spare part availability. This section describes and presents examples of the different reports that constitute the output of the Mission Degradation Module. These reports are:

- NSN of the first part, causing TMS to have zero flyable aircraft;
- Sorties Level Summary Report;
- Aircraft availability results;
- Mission Degradation Analysis Report;
- Reparable Spare Maintainability and Reliability Priority Analysis Report;

- Base Repair Costs/100 Largest Items;
- Depot Repair Costs/100 Largest Items;
- Condemnation Costs/100 Largest Items;
- Critical Parts Report.

The examples which follow are excerpts from a baseline run of the CAPLOG Model.

5. NSN of the First Part Causing a TMS to Have Zero Flyable Aircraft

The purpose of this report is to present a list of National Stock Numbers of the first part that causes a TMS to have zero flyable aircraft due to the unavailability of this spare part. A sample of the report is attached; immediately following is information on each column heading.

Column	Heading	Description
1	NSN	This column presents the National Stock Number of the first part causing zero flyable aircraft.
2	DAY	This column shows the day on which this part causes zero flyable aircraft.
3	TMS	This column shows which TMS has zero flyable aircraft.

EXHIBIT 12

NSN OF THE FIRST PART CAUSING A TMS TO HAVE ZERO FLYABLE AIRCRAFT

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 6 PAGE 8
CAP LOG-F01 4A DON ZIMMERMAN   8/06/82   UNCLASSIFIED

NSN OF THE FIRST PART CAUSING FOLLOWING MDS TO HAVE ZERO FLYABLE AIRCRAFT ON THAT GIVEN DAY

NSN	DAY	MDS
5895010313830000	40	F014A

EXHIBIT 13

SORTIES LEVEL SUMMARY REPORT

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 6 PAGE 9
CAP LOG-F01 4A DON ZIMMERMAN   11/06/82   UNCLASSIFIED

SUMMARY FOR 1981 (SPARES WITH ESSENTIALITY CODES A-J)

	DAY AT WHICH PERCENT SORTIES FLOWN REACH VARIOUS LEVELS				PERCENTAGE SORTIES FLOWN FOR VARIOUS MISSION DAYS						
	FIRST DAY BELOW				MISSION DAY						
TMS	100%	75%	50%	25%	5	10	15	20	30	45	60
F014A	70	84	109	0	100	100	100	100	100	100	100

6. Sorties Level Summary Report

This report provides the information about the first day at which percent sorties flown reach below the 100%, 75%, 50% and 25% levels, and percent sorties flown on the 5th, 10th, 15th, 20th, 30th, 45th, and 60th mission days.

A sample of this report follows. It defines the nature of the information presented under each of the column headings of the report.

DESCRIPTION OF SORTIE LEVEL SUMMARY REPORT

Column	Heading	Information
1	TMS	This column represents the user's specified TMS number for a particular run of the program.
2	100% (Level)	This column represents the first day at which percent sorties flown reach below 100% level.
3	75% (Level)	This column represents the first day at which percent sorties flown reach below 75% level.
4	50% (Level)	This column represents the first day at which percent sorties flown reach below 50% level.
5	25% (Level)	This column represents the first day at which percent sorties flown reach below 25% level.
6	5 (Mission day)	This column displays the percentage sorties flown on 5th mission day.
7	10 (Mission day)	This column displays the percentage sorties flown on 10th mission day.
8	15 (Mission day)	This columnn displays the percentage sorties flown on 15th mission day.
9	20 (Mission day)	This column displays the percentage sorties flown on 20th mission day.
10	30 (Mission day)	This column displays the percentage sorties flown on 30th mission day.
11	45 (Mission day)	This column displays the percentage sorties flown on 45th mission day.
12	60 (Mission day)	This column displays the percentage sorties flown on 60th mission day.

7. Aircraft Availability Results

The purpose of this report is to present the model's estimate of the percent of the orginal aircraft and the percent of the nonattrited aircraft that are available to perform Navy missions on selected days of the war.

A sample of this report is attached; immediately following is information on each column heading:

Column	Heading	Description
1	TMS	This column shows the TMS for which the information is given.
2	WAR DAY	The first row provides an estimate for the percent of the original aircraft available for Navy missions on selected days of the war. The second row provides an estimate for the percent of the nonattrited aircraft available for air mission on selected days of war.

EXHIBIT 14

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 6 PAGE 10
CAP LOG-F01 4A DON ZIMMERMAN   11/06/82   UNCLASSIFIED

LCMS OVERVIEW AIRCRAFT AVAILABILITY RESULTS
PERCENT ORIGINAL A/C AND PERCENT NON-ATTRITED A/C

TMS	WAR DAY 1	7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97	103	109	115
F014A	100.0	95.9	91.6	86.9	82.5	78.1	73.0	67.9	62.8	57.7	52.6	47.1	41.8	37.0	32.7	28.9	25.4	22.4	19.7	17.3
	100.0	96.2	96.0	93.4	91.0	88.4	84.8	81.1	77.1	72.9	68.5	63.3	57.6	52.7	47.8	43.3	39.0	35.0	31.4	28.1

8. <u>Mission Degradation Analysis Report</u>

The purpose of this report is to show what additional mission capability can be provided when USN policy permits aircraft to be cannibalized. There are three parts to this report. In Part 1 the mission degradation is shown by presenting the percent of scheduled sorties that are flown for each day. In Part 2 a "come as you are" war is presented when only serviceable assets apply and where standard base and depot repair times were maintained. In Part 3 the mission degradation is shown by comparing mission requirements to missions accomplished. Samples of all parts are included.

Part two of this report shows that as the war progresses the number of assembled aircraft (*) decrease. Also, as the war progresses, the number of cannibalized aircraft increases (+). The number of flyable aircraft (·) is smaller than the number of assembled aircraft because some assembled aircraft need spares before they are flyable. In this example, the percentage of missions flown (%) by flyable aircraft decreases until day 55 when repaired spares return from the depot. With their return, the percentage of missions flown increases, the number of flyable aircraft increases, and the number of cannibalized aircraft decreases.

Part three of this report shows which aircraft fail to meet the mission requirement by comparing the Daily Flying Hours Requirement (*) and the Flying Hours Accomplished (·) for each aircraft.

EXHIBIT 15

FUNCTION:REPRINT 13

MISSION DEGRADATION ANALYSIS REPORT

PART I

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE REPORT 11 PAGE 1
NAVY OURVIEW TS DON ZIMMERMAN 9/06/82 UNCLASSIFIED
NSNS FOR WHICH THE PEACE TIME USAGE EXCEEDS INITIAL INVENTORY LEVEL
LISTS IIL , TOTAL PEACE USAGE , PEACE CONDEMNATIONS , AND PEACE PIPELINE.
RESULTING IIL DECREASED BY 50%

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE REPORT 11 PAGE 2
NAVY OURVIEW TS DON ZIMMERMAN 9/06/82 UNCLASSIFIED

YEAR=1981 ATTRITION RATE USED: 0.0039 FOR MDS: 7014A

DAY	REQUIRED FLYING HOURS	SORTIE LENGTH	SORTIE RATE FLEET	SORTIE RATE EACH ACFT	ASSEMBLED AIRCRAFT	LOST BY ATTRITION	NMCS UNFLYABLE AIRCRAFT	NMCS PERCENT	FLYABLE AIRCRAFT	PERCENT SORTIES FLOWN	HOURS FLOWN	CUM HOURS FLOWN
1	518.	2.00	259.	1.00	259.	1.00	0.	0.	259.	100.	518.	518.
2	518.	2.00	259.	1.00	258.	1.00	0.	0.	258.	100.	518.	1036.
3	518.	2.00	259.	1.01	257.	1.00	0.	0.14	257.	100.	518.	1554.
4	518.	2.00	259.	1.02	256.	1.00	2.	0.59	254.	100.	518.	2072.
5	518.	2.00	259.	1.03	255.	1.00	3.	1.23	252.	100.	518.	2590.
6	518.	2.00	259.	1.04	254.	1.00	5.	1.87	249.	100.	518.	3108.
7	518.	2.00	259.	1.05	253.	1.00	6.	2.52	247.	100.	518.	3626.
8	518.	2.00	259.	1.06	252.	1.00	8.	3.18	244.	100.	518.	4144.
9	518.	2.00	259.	1.07	251.	1.00	10.	3.83	241.	100.	518.	4662.
10	518.	2.00	259.	1.08	250.	1.00	11.	4.50	239.	100.	518.	5180.
11	777.	2.00	389.	1.65	249.	1.00	13.	5.17	236.	100.	777.	5957.
12	777.	2.00	389.	1.67	249.	1.00	16.	6.41	232.	100.	777.	6734.
13	777.	2.00	389.	1.70	247.	1.00	18.	7.39	229.	100.	777.	7511.
14	777.	2.00	389.	1.72	246.	1.00	21.	8.39	225.	100.	777.	8288.
15	777.	2.00	389.	1.75	245.	1.00	23.	9.39	222.	100.	777.	9065.
16	622.	2.00	311.	1.42	244.	1.00	25.	10.45	219.	100.	622.	9687.
17	622.	2.00	311.	1.45	243.	1.00	28.	11.45	215.	100.	622.	10309.
18	622.	2.00	311.	1.47	242.	1.00	30.	12.54	212.	100.	622.	10931.
19	622.	2.00	311.	1.49	241.	1.00	33.	13.63	208.	100.	622.	11553.
20	622.	2.00	311.	1.52	240.	1.00	35.	14.73	205.	100.	622.	12175.
21	622.	2.00	311.	1.55	239.	1.00	38.	15.83	201.	100.	622.	12797.
22	622.	2.00	311.	1.57	238.	1.00	40.	16.95	198.	100.	622.	13419.
23	622.	2.00	311.	1.60	237.	1.00	42.	17.84	195.	100.	622.	14041.
24	622.	2.00	311.	1.63	236.	1.00	45.	18.91	191.	100.	622.	14663.
25	622.	2.00	311.	1.66	235.	1.00	47.	20.16	188.	100.	622.	15285.
26	622.	2.00	311.	1.69	234.	1.00	50.	21.23	184.	100.	622.	15907.
27	622.	2.00	311.	1.72	233.	1.00	52.	22.32	181.	100.	622.	16529.
28	622.	2.00	311.	1.75	232.	1.00	55.	23.56	177.	100.	622.	17151.
29	622.	2.00	311.	1.79	231.	1.00	57.	24.82	174.	100.	622.	17773.
30	622.	2.00	311.	1.83	230.	1.00	60.	26.06	170.	100.	622.	18395.
31	829.	2.00	415.	2.48	229.	1.00	62.	27.01	167.	100.	829.	19224.
32	829.	2.00	415.	2.56	228.	1.00	66.	28.90	162.	100.	829.	20053.
33	829.	2.00	415.	2.64	227.	1.00	70.	30.82	157.	100.	829.	20882.
34	829.	2.00	415.	2.73	226.	1.00	74.	32.74	152.	100.	829.	21711.
35	829.	2.00	415.	2.82	225.	1.00	78.	34.71	147.	100.	829.	22540.
36	829.	2.00	415.	2.91	224.	1.00	82.	36.51	142.	100.	829.	23369.
37	829.	2.00	415.	3.01	223.	1.00	85.	38.33	138.	100.	829.	24198.
38	829.	2.00	415.	3.12	222.	1.00	89.	40.16	133.	100.	829.	25027.
39	829.	2.00	415.	3.23	221.	1.00	93.	42.01	128.	100.	829.	25856.
40	829.	2.00	415.	3.36	220.	1.00	97.	43.88	123.	100.	829.	26685.
41	829.	2.00	415.	3.48	219.	1.00	100.	45.61	119.	100.	829.	27514.
42	829.	2.00	415.	3.61	218.	1.00	103.	47.31	115.	100.	829.	28343.
43	829.	2.00	415.	3.73	217.	1.00	106.	48.82	111.	100.	829.	29172.
44	829.	2.00	415.	3.86	216.	1.00	109.	50.33	107.	100.	829.	30001.
45	829.	2.00	415.	4.00	215.	1.00	112.	51.86	103.	100.	829.	30829.
46	829.	2.00	415.	4.00	214.	0.96	115.	53.57	99.	96.	795.	31624.
47	829.	2.00	415.	4.00	213.	0.92	118.	55.27	95.	92.	762.	32386.
48	829.	2.00	415.	4.00	212.	0.89	120.	56.72	92.	89.	734.	33121.
49	829.	2.00	415.	4.00	211.	0.85	123.	58.16	88.	85.	707.	33828.
50	829.	2.00	415.	4.00	210.	0.82	125.	59.56	85.	82.	681.	34508.
51	829.	2.00	415.	4.00	210.	0.79	129.	60.95	82.	79.	655.	35163.
52	829.	2.00	415.	4.00	209.	0.76	130.	62.27	79.	76.	630.	35793.
53	829.	2.00	415.	4.00	208.	0.73	132.	63.55	76.	73.	607.	36400.
54	829.	2.00	415.	4.00	207.	0.70	134.	64.82	73.	70.	583.	36983.
55	829.	2.00	415.	4.00	207.	0.68	136.	66.05	70.	68.	561.	37544.

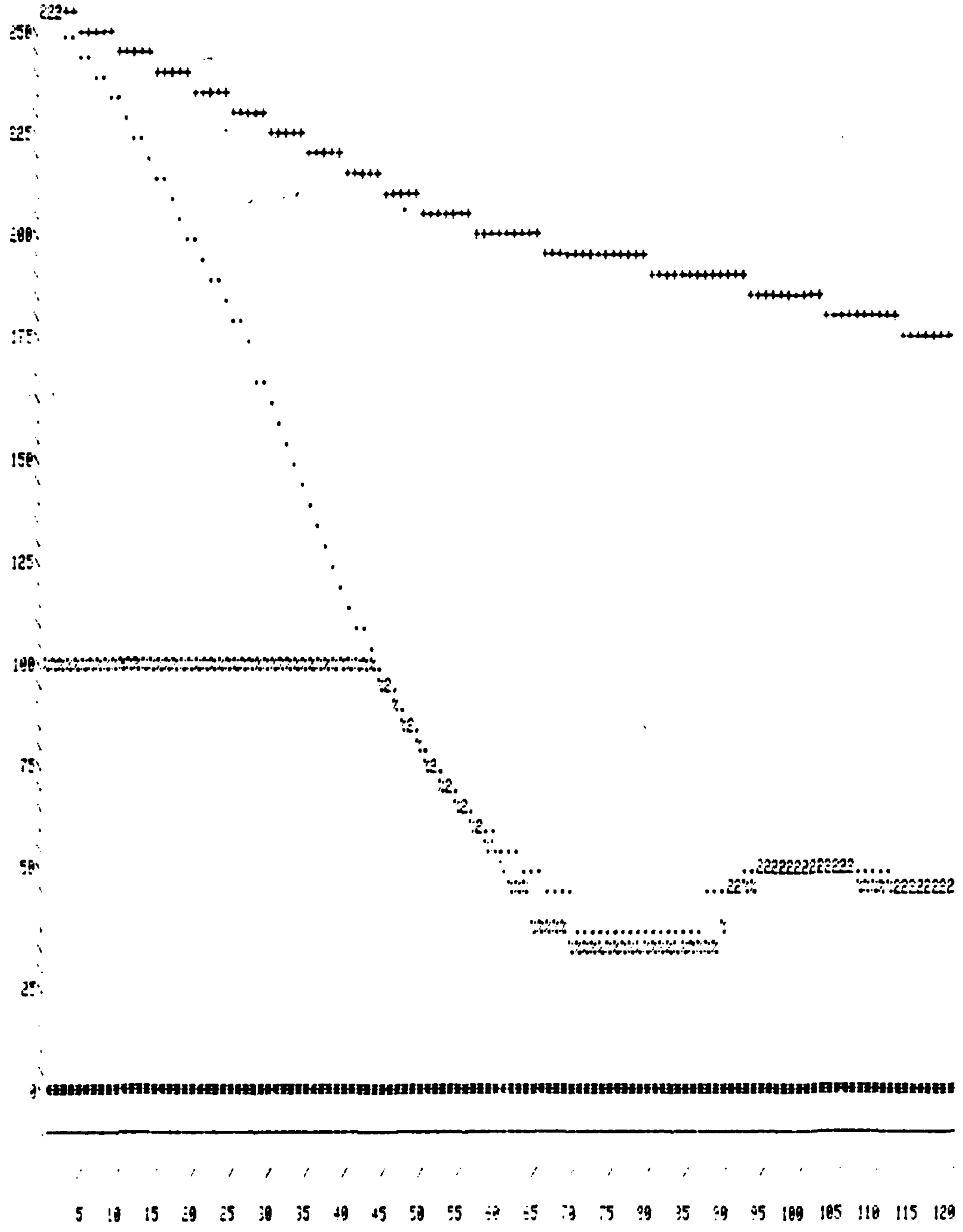
EXHIBIT 16

MISSION DEGRADATION ANALYSIS REPORT

FUNCTION?REPRINT 14

PART II

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE REPORT 12 PAGE 1
NAV OVERVIEW TO DON ZIMMERMAN 8/06/82 UNCLASSIFIED



2 - MORE THAN ONE OBSERVATN
. - FLYABLE AIRCRAFT
% - PERCENT MISSIONS FLOWN
# - CANNIBALIZED AIRCRAFT
+ - ASSEMBLED AIRCRAFT

YEAR=1981 ATTRITION RATE USED: 0.0039 FOR MDS: F014A

END OF 14
FUNCTION?

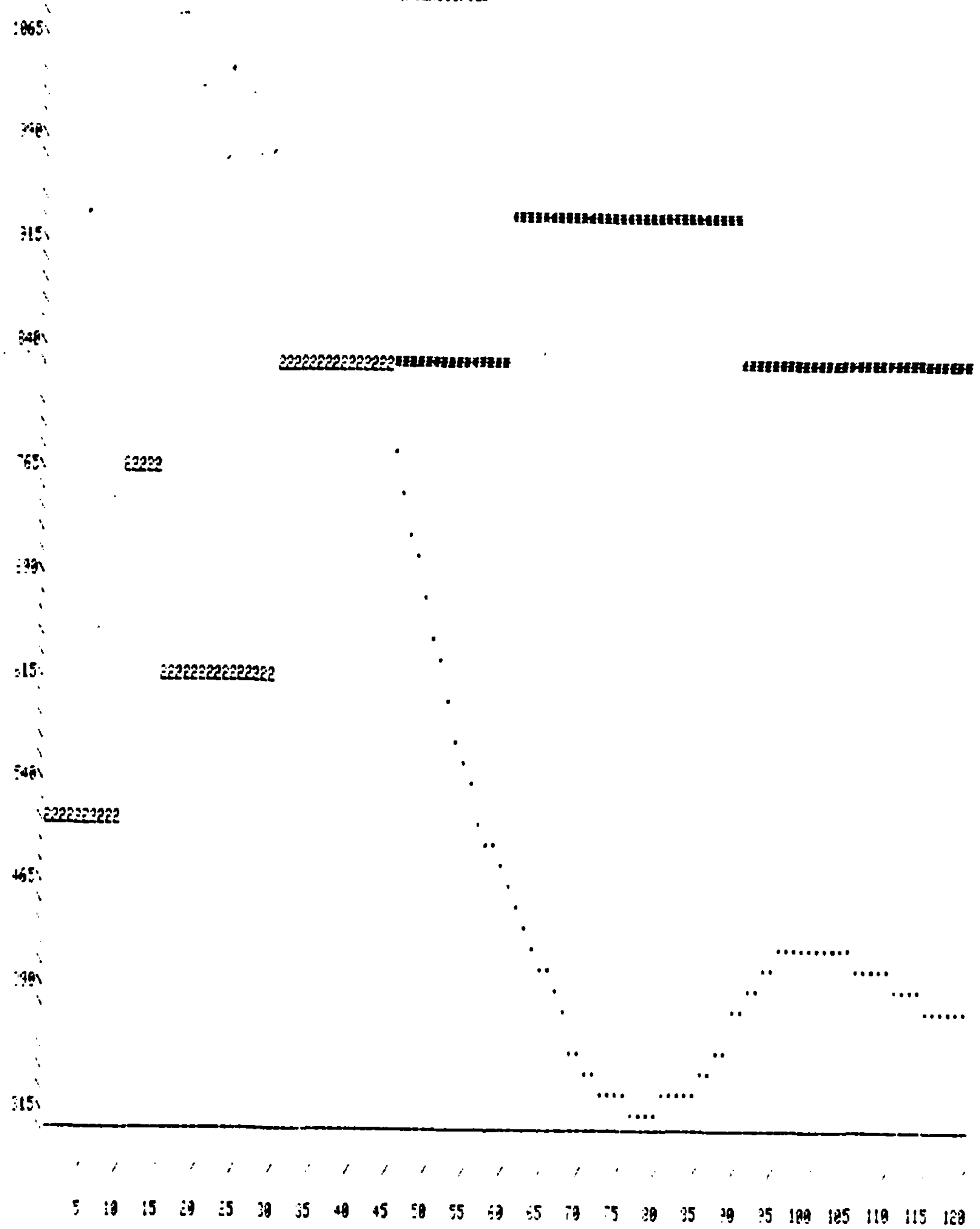
EFRINT 15

EXHIBIT 17

MISSION DEGRADATION ANALYSIS REPORT

PART 3

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE REPORT 12 PAGE 1
MCY OVERVIEW TS DON ZIMMERMAN 3/06/82 UNCLASSIFIED



2 - MORE THAN ONE OBSERVATN # - MISSION REQUIREMENTS
. - MISSIONS ACCOMPLISHED

YEAR=1991 ATTRITION RATE USED: 0.0039 FOR MDS: F0149

END OF 15

Mission Degradation Analysis Report

Part 1

Column	Heading	Information
1	DAY	This column shows the number of days since the beginning of the time period being analyzed.
2	REQUIRED FLYING HOURS	This column shows the number of flight hours that the particular TMS being studied must fly on the day shown on the same line in order to satisfy the USN mission requirement for that TMS.
3	SORTIE LENGTH	This column shows the average number of flight hours required for each aircraft on each sortie flown on the day shown on the same line.
4	NUMBER OF AIRCRAFT SORTIES	This column shows the number of aircraft sorties which must be flown on the day shown to satisfy the USN mission require-ment for that day. The number of sorties is obtained by dividing Required Flying Hours (Column 2) by Sortie Length (Column 3) and rounding up to the next whole number.
5	SORTIES PER AIRCRAFT	This column shows the number of sorties flown by each aircraft that flies missions on the day shown. This number is obtained by dividing number of Aircraft Sorties (Column 4) by Flyable Aircraft (Column 11).
6	ASSEMBLED AIRCRAFT	This column shows the number of assembled aircraft available to carry out the mission on the day shown. The number that appears on any day is equal to the number presented on the previous day minus those aircraft lost by attrition on the previous day.

Column	Heading	Information
7	LOST BY ATTRITION	This column shows the number of aircraft that were lost by attrition on the day shown. The number is obtained by multiplying the attrition percentage (not shown) by the Number of Aircraft Sorties (Column 4).
8	NCMS UNFLYABLE AIRCRAFT	This column shows the number of assembled aircraft that cannot fly because they are missing a spare part on the day shown, and the part missing cannot be obtained either from inventory or from other NMCS aircraft.
9	NMCS PCNT	This column shows the rates of NMCS unflyable aircraft to assembled aircraft.
10	FLYABLE AIRCRAFT	This column shows the number of aircraft that are flyable on the day shown. The number is obtained by subtracting the number of unflyable aircraft (Column 7 + Column 8) from Assembled Aircraft (Column 6).
11	PERCENT SORTIES FLOWN	This column shows the percent of required sorties flown.
12	HOURS FLOWN	This column shows the total number of flight hours the model estimates will be flown on that day.
13	PART NUMBER/CUM HOURS FLOWN	This column shows the cumulative flight hours the model estimates will be flown up to that point in time.

9. Reparable Spare Maintainability and Reliability Priority Analysis Report

This report is produced by the Mission Degradation Module. In it, the total dollar cost for buying, repairing, and condemning all parts that are used to support a given force structure of TMS for a specified flight program is first computed. These parts are then sorted and arranged in order of highest total cost. The first 100 parts on this list are those which require the most money to replace; from them the report gets its nickname: "100 Greatest Thieves Report."

A sample of this report is attached; immediately following is information on each of the column headings:

Column	Heading	Information
1	PART NUMBER	This column shows the MSN of a particular reparable spare.
2	TOTAL COST	This column shows the total dollar cost required to purchase and repair the part throughout the flight program.
3	FAILURES	This column shows the total number of failures of the part which occurred during the flight program.
4	BASE REPS	This column shows the total number of the part repaired at the base repair shops to support the flight program.
5	DEPOT REPS	This column shows the total number of the part repaired at the depot repair shops to support the flight program.
6	CONDEMNED	This column shows the total number of the part condemned to support the flight program.

EXHIBIT 18

REPARABLE SPARE MAINTAINABILITY AND RELIABILITY PRIORITY ANALYSIS

	MASTER STOCK NO	TOTAL COST	FAILURES	BASE REPS	DEPOT REPS	CONDEMNED
1	6605010623909	48863737.	1356.	1332.	40.	0.
2	1430001216932	24581887.	590.	403.	171.	2.
3	1430004217021	12845367.	426.	377.	53.	1.
4	1430001488475	12408930.	476.	455.	23.	0.
5	1430001425512	11918964.	942.	953.	10.	0.
6	1430010175299	11716380.	1322.	1316.	14.	0.
7	5915004655066	10660550.	518.	388.	136.	1.
8	1430010734475	10571580.	581.	564.	27.	0.
9	1430001217299	10372745.	895.	879.	18.	0.
10	1430001239369	9036817.	698.	686.	21.	0.
11	1650006191673	8189419.	862.	514.	357.	11.
12	1035006300762	7921572.	586.	472.	115.	1.
13	1430001228112	7273659.	699.	681.	18.	0.
14	5895010313833	6941856.	492.	481.	16.	0.
15	1630010600941	6791798.	702.	14.	584.	69.
16	5895010313664	6382489.	355.	335.	22.	0.
17	6610010199233	6185504.	609.	581.	38.	0.
18	1430001217359	5248926.	545.	531.	12.	0.
19	1430001236781	5057652.	675.	664.	13.	0.
20	1430001238886	4485658.	500.	487.	14.	0.
21	1270001487299	4360558.	657.	639.	24.	0.
22	5960001306794	4184077.	226.	0.	126.	77.
23	1430010138638	4176419.	427.	420.	9.	4.
24	1440010123294	4157233.	1685.	1386.	328.	10.
25	6605010110855	3239081.	119.	26.	96.	0.
26	1430001239376	3001687.	340.	286.	59.	1.
27	1430001216946	2727379.	434.	432.	4.	0.
28	6605005201526	2651206.	85.	85.	2.	0.
29	1430010867689	2514237.	373.	369.	7.	0.
30	1440000513187	2194358.	1059.	266.	452.	238.
31	6610010107093	1788376.	448.	430.	28.	0.
32	5865001345421	1761106.	131.	123.	9.	2.
33	5895008148395	1695920.	508.	500.	16.	0.
34	6605019041603	1692501.	128.	129.	2.	0.
35	1270010518683	1575354.	347.	348.	4.	0.
36	1270001487262	1564923.	337.	331.	8.	0.
37	5826001688769	1454434.	711.	688.	33.	0.
38	5865010663265	1330902.	186.	181.	7.	0.
39	5895001490701	1343557.	74.	63.	9.	0.
40	6130010299187	1313458.	89.	83.	7.	0.
41	6615001376538	1246003.	451.	50.	412.	4.
42	6615010912877	1202019.	217.	211.	10.	0.
43	1430001530347	1186745.	182.	2.	146.	2.
44	5895001406908	1125492.	141.	138.	6.	0.
45	6615001592290	1048840.	115.	6.	112.	1.
46	5895001490698	1046686.	101.	88.	11.	0.
47	6605004112317	1026064.	409.	0.	410.	20.
48	6115001618782	990843.	845.	501.	323.	35.
49	5895002395200	941573.	110.	88.	26.	0.
50	1560010295013	938329.	37.	32.	5.	1.

45

10. Base Repair Cost/100 Largest Items

This report presents the Master Stock Number of the 100 items with the largest base repair cost. This report provides information on the number and type of items and type of items that require the most dollar resources at the base repair facility needed to support a given wartime flying hour program. A sample of the report is attached; and the following defines the nature of the information presented under each of the column headings of this report.

Column	Heading	Information
1	MASTER STOCK NUMBER	This column shows the Master Stock Number of the items to be repaired at the base.
2	TOTAL COST	This column shows the total wartime base repair cost for this MSN.
3	NUMBER	This column shows the total number of wartime base repairs repaired at the base.

EXHIBIT 19

BASE REPAIR COSTS/100 LARGEST ITEMS

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE REPORT 6 PAGE 11
MARCH 1982 CALVERT HOCKER 10/14/82 UNCLASSIFIED

BASE REPAIR COSTS/ 100 LARGEST ITEMS

	MASTER STOCK NO	TOTAL COST	NUMBER
1	6605010944518	1572949.	236.
2	1270010896267	613540.	114.
3	1270010608417	271453.	214.
4	5865011078226EW	197212.	363.
5	1095004767947	182874.	598.
6	5865011040866EW	155574.	130.
7	1630011158736	146025.	1043.
8	5865010456760EW	127149.	285.
9	5865010446369EW	103742.	130.
10	5895005391911	93719.	165.
11	1630010627046	88058.	138.
12	2995010481871	65099.	128.
13	5865001370491EW	60782.	32.
14	1270010575160	56632.	139.
15	5865010489029EW	49962.	43.
16	5821009338987	49674.	173.
17	2840010613808TB	47444.	4.
18	1270010322958	47214.	85.
19	6760004247984	38165.	134.
20	5821010512886	36943.	135.
21	1560010832648FJ	35848.	40.
22	5821010401755	28755.	108.
23	1270010797619	27367.	35.
24	1270010659465	24016.	22.
25	6340010576299	19853.	61.
26	1630005969637	19114.	486.
27	5826010883650	18550.	64.
28	6615011032953	18294.	46.
29	2995010650082	17347.	37.
30	5865004263144EW	16766.	168.
31	1095004767948	16471.	89.
32	5821006015131	16459.	80.
33	5820010762453CX	16351.	124.
34	5820010762454CX	16351.	124.
35	1270010686457	14115.	28.
36	6615010213681	13843.	19.
37	6610010996186	13721.	9.
38	5821010569616	13196.	71.
39	2840011096247TB	13166.	3.
40	5865010920386EW	12786.	85.
41	5821010621019	12653.	56.
42	1660005678852	12112.	56.
43	6760004051090	11564.	58.
44	5826010409798WF	11051.	22.
45	5865003713344EW	10932.	44.
46	5821010031336	10256.	68.
47	1650010175811	10071.	25.
48	5865010805675EW	9957.	55.
49	5821011041625	9816.	9.
50	5821010773721	9801.	124.
51	6615010330627	9450.	74.
52	1270010844185	8788.	16.
53	1270010608346	8786.	28.
54	5865011040864EW	8617.	78.
55	5821010665318	8569.	54.
56	1560010462741FJ	8560.	1.
57	5821010680337	7940.	67.
58	2840010419574TB	7896.	2.

11. Depot Repair Cost/100 Largest Items

This report presents the Master Stock Number of the 100 items with the largest depot repair cost. This report provides information on the number and type of items that require the most dollar resources at depot repair facility to support a given wartime flying hour program.

A sample of the report is attached, and the following defines the nature of the information presented under each of the column headings of this report.

Column	Heading	Information
1	MASTER STOCK NUMBER	This column shows the Master Stock Number of the item to be repaired at the depot.
2	TOTAL COST	This column shows the total wartime depot repair cost by NSN.
3	NUMBER	This column shows the total number of wartime depot repairs.

EXHIBIT 20

DEPOT REPAIR COSTS/100 LARGEST ITEMS

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE REPORT 6 PAGE 14
MARCH 1952 CALVERT HOCKER 10/14/82 UNCLASSIFIED

DEPOT REPAIR COSTS/ 100 LARGEST ITEMS

	MASTER STOCK NO	TOTAL COST	NUMBER
1	6605010944518	3045981.	152.
2	284001061380818	1389021.	35.
3	28400110962471B	510188.	36.
4	5865003713344EW	404995.	545.
5	5865010815247EW	273119.	34.
6	6610000848695	245187.	2075.
7	5960010404441EW	241758.	30.
8	5865011040866EW	210330.	59.
9	5865010976255EW	207484.	53.
10	28400111694911B	204298.	17.
11	5865034764443EW	191329.	46.
12	5865004764442EW	184808.	36.
13	4920011081329FJ	169385.	53.
14	6610010996186	148555.	33.
15	5865010446369EW	140202.	58.
16	5865010815249EW	133781.	17.
17	5865011078226EW	126643.	78.
18	5965007598099EW	124714.	22.
19	6605010987557	122912.	88.
20	5960010404442EW	119855.	15.
21	28400059573281B	119159.	5.
22	5960010404440EW	116886.	15.
23	5865010456755EW	116311.	17.
24	5865002490554EW	110098.	11.
25	5865010489029EW	98333.	28.
26	5865010447643EW	95008.	14.
27	5865010894016EW	90906.	53.
28	2995010481871	73918.	48.
29	5895005391911	71997.	42.
30	1270010109119	70369.	27.
31	28400105330551B	70209.	10.
32	6610001516672	66885.	65.
33	6615010213681	66312.	31.
34	2910010860714	66122.	32.
35	1270010896267	64707.	4.
36	5865000094381EW	64677.	11.
37	28400103043991B	61751.	4.
38	1650010134753	55505.	33.
39	6110010230715	54134.	93.
40	6610009988765	53947.	75.
41	5865010363289EW	53159.	39.
42	2995006141284	52211.	56.
43	1680010351386	49700.	45.
44	5865011156381EW	49082.	29.
45	5865010456760EW	46427.	35.
46	5865000232806EW	46164.	15.
47	5865010732345EW	45652.	68.
48	5865011156488EW	44615.	74.
49	1620010472009	44210.	6.
50	29150101529221B	42042.	20.
51	2995010489580	41576.	19.
52	5826010883650	40109.	46.
53	1650010129154	39910.	27.
54	5865001994210EW	39167.	73.
55	5865010920386EW	37788.	84.
56	5865010211731EW	36863.	85.
57	284000596882518	36704.	36.
58	661000[illegible]217635	[illegible]	76.

12. <u>Condemnation Costs/100 Largest Items</u>

This report presents the Master Stock Number of the 100 items with the largest condemnation cost. This report provides information on the number and type of items that cost the Air Force the most in terms of condemnation cost.

A sample of the report follows, and the following defines the nature of the information presented under each of the column headings of this report.

Column	Heading	Description
1	MASTER STOCK NUMBER	This column shows the Master Stock Number of the item condemned.
2	TOTAL COST	This column shows the total condemnation cost for this item.
3	NUMBER	This column shows the number of item condemned.

EXHIBIT 21

CONDEMNATION COSTS /100 LARGEST ITEMS

CONDEMNATION COSTS/ 100 LARGEST ITEMS

	MASTER STOCK NO	TOTAL COST	NUMBER
1	5865001559266EW	2063617.	225.
2	5865004754443EW	735015.	65.
3	5865010456755EW	690399.	41.
4	5865010447643EW	669373.	46.
5	5960010404442EW	452961.	41.
6	5865003713344EW	412236.	62.
7	5960010404440EW	285553.	17.
8	2840006053212TB	188805.	71.
9	5865004360237EW	176980.	45.
10	5865000094382EW	170022.	28.
11	5865010456754EW	153774.	9.
12	2840010041804TB	149719.	48.
13	5865004764442EW	135118.	17.
14	5960010404441EW	134892.	11.
15	2840010304399TB	127833.	2.
16	2840011069803TB	93061.	7.
17	2840011169491TB	85168.	1.
18	1630011158736	81908.	28.
19	2840005957328TB	73984.	1.
20	5865007598099EW	68979.	9.
21	5865000076949EW	64121.	14.
22	5865000094381EW	50378.	5.
23	2935010774052	48746.	20.
24	5865000233292EW	45948.	12.
25	5865002790484EW	45945.	21.
26	5865010489029EW	40895.	1.
27	5865000076945EW	39166.	12.
28	2835010377466	35185.	12.
29	6610001516721	34761.	7.
30	5865011070151EW	33850.	5.
31	5865011078226EW	29058.	1.
32	2840010938737TB	26470.	1.
33	2840011160972TB	24624.	2.
34	1270010109119	22150.	0.
35	2995010489580	21999.	2.
36	5821010581073	21115.	2.
37	4920011081329FJ	19510.	1.
38	2995006141284	19211.	9.
39	5865010363172EW	19001.	9.
40	5865002490554EW	18149.	1.
41	2840010612134TB	17113.	17.
42	2840006053213TB	16558.	4.
43	6125004499778	16074.	6.
44	5865010456760EW	15095.	1.
45	6685003709816TB	14464.	11.
46	2835010131964	14304.	22.
47	2935010481927TB	13768.	5.
48	2840011159594TB	13282.	2.
49	2840010779171TB	13185.	1.
50	1630010627046	12807.	2.
51	6610001516672	12334.	1.
52	5826010883650	11484.	2.
53	5821006112447	11226.	3.
54	2835010134806	11064.	10.
55	2835010115718	10888.	5.
56	2840010279823TB	10718.	1.
57	4810010723306TP	10467.	4.
58	1560010350646FJ	10057.	1.

13. Critical Parts Report

A detailed critical parts report was created to fully identify the parts causing the aircraft to be grounded. This report contains all of the associated variables used by the model in making this determination.

The report contains:

(a) Day of failure

(b) Master Stock Number

(c) Initial Inventory

(d) Parts on hand

(e) Failure rate

(f) Base condemnation percent

(g) Depot condemnation percent

(h) Base return time (in days)

(i) Depot return time (in days)

(j) Percent not reparable this station.

A separate FORTRAN program was used to sort the original master ASO file and extract the desires nomenclature identifying each critical spare.

EXHIBIT 22

C R I T I C A L   P A R T S   L I S T;

DAY	MASTER STOCK NO	INIT INV	POH	FL RATE	BC %	DC %	BRT	DRT	MRTS
1	0000000000000	0.	0.	0.	0.	0.	0.	0.	0.
2	6615010749957	0.	368.	0.000060	0.80	0.	2.	0.	0.
3	6615010749957	0.	366.	0.000060	0.80	0.	2.	0.	0.
4	6615010749957	0.	365.	0.000060	0.80	0.	2.	0.	0.
5	5895010313832	0.	363.	0.000692	0.	0.01	20.	180.	0.03
6	5895010313832	0.	361.	0.000692	0.	0.01	20.	180.	0.03
7	5895010313832	0.	359.	0.000692	0.	0.01	20.	180.	0.03
8	5895010313832	0.	357.	0.000692	0.	0.01	20.	130.	0.03
9	5895010313832	0.	355.	0.000692	0.	0.01	20.	180.	0.03
10	5895010313832	0.	353.	0.000692	0.	0.01	20.	180.	0.03
11	5895010313832	0.	351.	0.000692	0.	0.01	20.	180.	0.03
12	1630001645991	8.	348.	0.017604	0.	0.46	3.	81.	0.16
13	1630001645991	8.	344.	0.017604	0.	0.46	3.	81.	0.16
14	1630001645991	8.	341.	0.017604	0.	0.46	3.	81.	0.16
15	1630001645991	8.	337.	0.017604	0.	0.46	3.	81.	0.16
16	1630001645991	8.	334.	0.017604	0.	0.46	3.	81.	0.16
17	1630001645991	8.	329.	0.017604	0.	0.46	3.	81.	0.16
18	1630001645991	8.	324.	0.017604	0.	0.46	3.	81.	0.16
19	1630001645991	8.	320.	0.017604	0.	0.46	3.	81.	0.16
20	1630001645991	8.	315.	0.017604	0.	0.46	3.	81.	0.16
21	1630001645991	8.	311.	0.017604	0.	0.46	3.	81.	0.16
22	1630001645991	8.	306.	0.017604	0.	0.46	3.	81.	0.16
23	1630001645991	8.	302.	0.017604	0.	0.46	3.	81.	0.16
24	1630001645991	8.	297.	0.017604	0.	0.46	3.	81.	0.16
25	1630001645991	8.	293.	0.017604	0.	0.46	3.	81.	0.16
26	1630001645991	8.	288.	0.017604	0.	0.46	3.	81.	0.16
27	1630001645991	8.	283.	0.017604	0.	0.46	3.	81.	0.16
28	1630001645991	8.	278.	0.017604	0.	0.46	3.	81.	0.16
29	1630001645991	8.	273.	0.017604	0.	0.46	3.	81.	0.16
30	1630001645991	8.	268.	0.017604	0.	0.46	3.	81.	0.16
31	1630001645991	8.	263.	0.017604	0.	0.46	3.	81.	0.16
32	1630001645991	8.	259.	0.017604	0.	0.46	3.	81.	0.16
33	1630001645991	8.	254.	0.017604	0.	0.46	3.	81.	0.16
34	1630001645991	8.	251.	0.017604	0.	0.46	3.	81.	0.16
35	1630001645991	8.	248.	0.017604	0.	0.46	3.	81.	0.16
36	1630001645991	8.	244.	0.017604	0.	0.46	3.	81.	0.16
37	1630001645991	8.	241.	0.017604	0.	0.46	3.	81.	0.16
38	1630001645991	8.	238.	0.017604	0.	0.46	3.	81.	0.16
39	1630001645991	8.	234.	0.017604	0.	0.46	3.	81.	0.16
40	1630001645991	8.	231.	0.017604	0.	0.46	3.	81.	0.16
41	1630001645991	8.	228.	0.017604	0.	0.46	3.	81.	0.16
42	1630001645991	8.	224.	0.017604	0.	0.46	3.	81.	0.16
43	1630001645991	8.	220.	0.017604	0.	0.46	3.	81.	0.16
44	1630001645991	8.	217.	0.017604	0.	0.46	3.	81.	0.16
45	1630001645991	8.	213.	0.017604	0.	0.46	3.	81.	0.16
46	1630001645991	8.	209.	0.017604	0.	0.46	3.	81.	0.16
47	1630001645991	8.	206.	0.017604	0.	0.46	3.	81.	0.16
48	1630001645991	8.	202.	0.017604	0.	0.46	3.	81.	0.16
49	1630001645991	8.	198.	0.017604	0.	0.46	3.	81.	0.16
50	1630001645991	8.	195.	0.017604	0.	0.46	3.	81.	0.16
51	1630001645991	8.	191.	0.017604	0.	0.46	3.	81.	0.16
52	1630001645991	8.	188.	0.017604	0.	0.46	3.	81.	0.16
53	1630001645991	8.	184.	0.017604	0.	0.46	3.	81.	0.16
54	1630001645991	8.	181.	0.017604	0.	0.46	3.	81.	0.16
55	1630001645991	8.	178.	0.017604	0.	0.46	3.	81.	0.16
56	1630001645991	8.	175.	0.017604	0.	0.46	3.	81.	0.16
57	1630001645991	8.	172.	0.017604	0.	0.46	3.	81.	0.16
58	1630001645991	8.	169.	0.017604	0.	0.46	3.	81.	0.16
59	1630001645991	8.	167.	0.017604	0.	0.46	3.	81.	0.16
60	1630001645991	8.	164.	0.017604	0.	0.46	3.	81.	0.16
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

14. This section presents examples of the following output reports:

- Data Control Section
- Data Processing Section
- MSNs for which Peacetime Usage Exceeds Initial Inventory Level
- Mission Degradation Report
- Mission Degradation Plots
- Data Base Listing Report

EXHIBIT 23

DATA CONTROL SECTION

OPP LOG-XXX AX
XXXXX
DONE

DATA CONTROL SECTION:

ITEM LEVEL PARAMETER	FACTOR	MIN	MAX
UNIT COST	1.00	0.	0.
ADMIN LEAD TIME	1.00	0.	0.
PRODUCTION LEAD TIME	1.00	0.	0.
ORDER AND SHIP TIME	1.00	0.	0.
DEMAND RATE	1.00	0.	0.
BCM %	1.00	0.	0.
UNIT REPAIR TIME	1.00	0.	0.
DEPOT REPAIR TIME	1.00	0.	0.
UNIT CONDEMNATION %	1.00	0.	0.
DEPOT CONDEMNATION %	1.00	0.	0.
UNIT REPAIR COST	1.00	0.	0.
SERVICEABLE PEACE	1.00	0.	0.
SERVICEABLE WAR	1.00	0.	0.
UNSERVICEABLE PEACE	1.00	0.	0.
UNSERVICEABLE WAR	1.00	0.	0.
ON ORDER ASSETS	1.00	0.	0.
ESSENTIALITY LEVEL	10.00	0.	0.
CANNIBALIZATION	1.00	0.	0.
CRITICAL ITEM LIST	100.00	0.	0.
CRITICAL ITEM SORT	0.	0.	0.

OPTIONAL REPORTS REQUESTED:

REPORT 11	YES
REPORT 12	YES
REPORT 13	YES
REPORT 14	YES
REPORT 15	YES
REPORT 16	NO
REPORT 17	NO

THESE MDS WILL BE USED IN THIS RUN OF THE MODEL:

1 XXXXX

THESE FSC WILL BE USED IN THIS RUN OF THE MODEL:

ALL FSC WILL BE USED.

EXHIBIT 24

DATA BASE PROCESSING SECTION:

SUMMARY OF MASTER STOCK NUMBER SELECTION:

```
TOTAL MSN'S PROCESSED IN DATA BASE             = 2033
MSN'S WITH ESSENTIALITY LEVEL > THAN     10    =    0
MSN'S WITH DEMAND RATE OF ZERO                 =    2
MSN'S NOT APPLICABLE TO FSC USED IN THIS RUN   =    0
MSN'S NOT APPLICABLE TO MDS USED IN THIS RUN   =    0
MSN'S NOT APPLICABLE TO ALC USED IN THIS RUN   =    0
MSN'S NOT APPLICABLE TO MSN LIST IN THIS RUN   =    0
MSN'S IN MSN LIST BUT NOT IN OVERVIEW DATABASE=    0
TOTAL MSN'S SELECTED FOR THIS RUN              = 2031
```

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 6 PAGE 1
CAP LOG-XXX XX DON ZIMMERMAN   03/09/83   UNCLASSIFIED

RUN CONTROL SECTION:

```
YEAR          =  1981
PEACE DAYS    =   365
WAR DAYS      =   120
```

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 6 PAGE 2
CAP LOG-XXX XX DON ZIMMERMAN   03/09/83   UNCLASSIFIED

FLYING PROGRAM FOR 1981:

		PEACETIME FLY HRS/DAY		WARTIME FLY HRS/DAY															
MDS	#ACFT	EACH ACFT	WHOLE FLEET	EACH ACFT	1 16 31-45	2 17 46-60	3 18 61-90	4 19 -120	5 20 -150	6 21 -180	7 22	8 23	9 24	10 25	11 26	12 27	13 28	14 29	15 30
XXXXX	370	1.08	400	2.82	574	574	574	574	574	543	543	543	543	543	605	605	605	605	605
					616	616	616	616	616	616	616	616	616	616	616	616	616	616	616
					669	669	657	595	595	595									

<u>EXHIBIT 25</u>

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 11 PAGE   1
CAP LOG-XXX XX DON ZIMMERMAN   03/09/83   UNCLASSIFIED
NSNS FOR WHICH THE PEACE TIME USAGE EXCEEDS INITIAL INVENTORY LEVEL
LISTS IIL , TOTAL PEACE USAGE , PEACE CONDEMNATIONS , AND PEACE PIPELINE.
RESULTING IIL DECREASED BY 50%

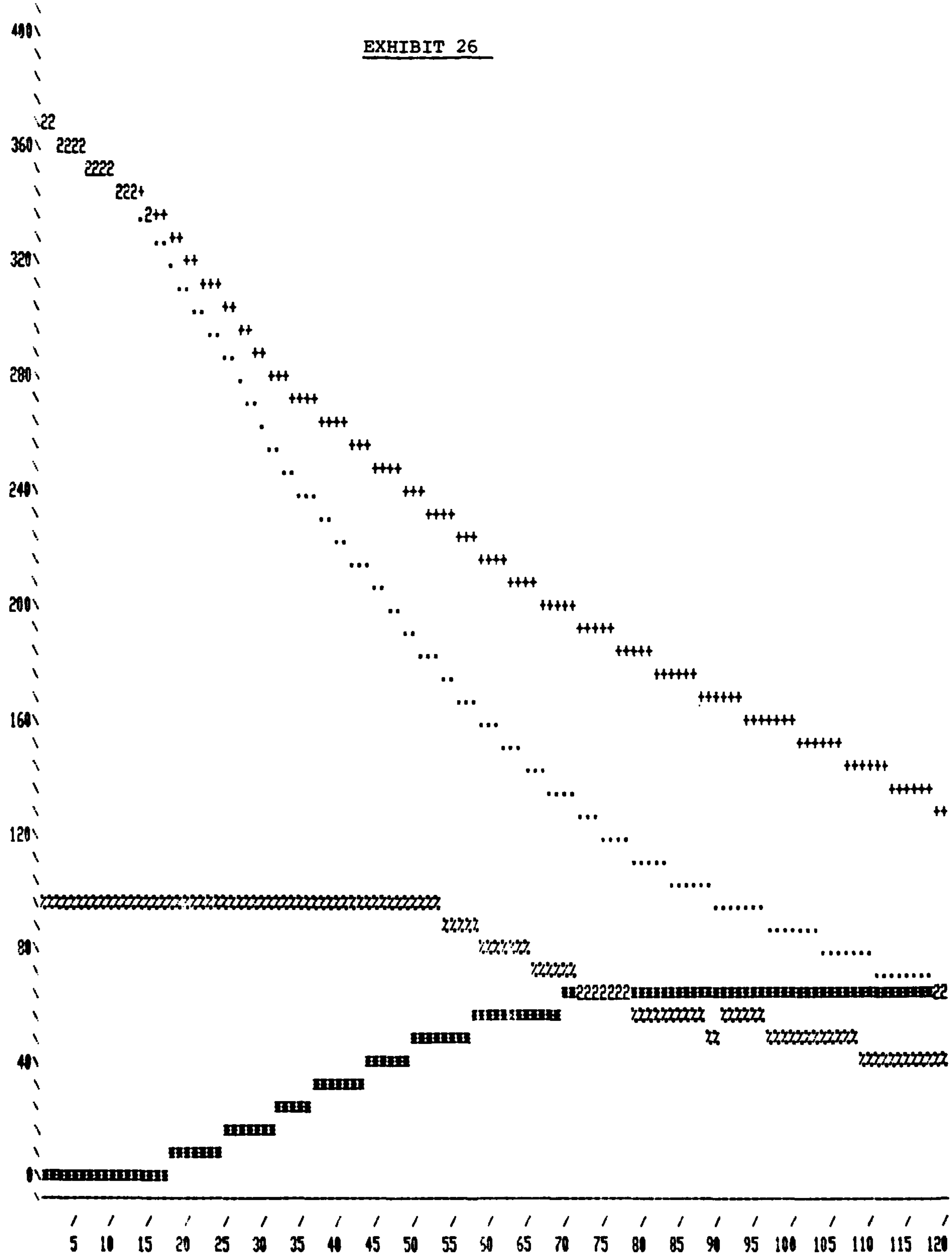
SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 11 PAGE   2
CAP LOG-XXX XX DON ZIMMERMAN   03/09/83   UNCLASSIFIED

YEAR=1981   ATTRITION RATE USED: 0.0063   FOR MDS: XXXXX

DAY	REQUIRED FLYING HOURS	SORTIE LENGTH	SORTIE RATE FLEET	SORTIE RATE EACH ACFT	ASSEMBLED AIRCRAFT	LOST BY ATTRITION	NMCS UNFLYABLE AIRCRAFT	NMCS PERCENT	FLYABLE AIRCRAFT	PERCENT SORTIES FLOWN	HOURS FLOWN	CUM HOURS FLOWN
1	574.	2.00	287.	0.78	370.	1.80	0.	0.	370.	100.	574.	574.
2	574.	2.00	287.	0.78	368.	1.80	0.	0.01	368.	100.	574.	1148.
3	574.	2.00	287.	0.78	366.	1.80	0.	0.01	366.	100.	574.	1722.
4	574.	2.00	287.	0.79	365.	1.80	0.	0.02	365.	100.	574.	2296.
5	574.	2.00	287.	0.79	363.	1.80	0.	0.05	363.	100.	574.	2870.
6	543.	2.00	272.	0.75	361.	1.80	0.	0.09	361.	100.	543.	3413.
7	543.	2.00	272.	0.76	359.	1.80	0.	0.11	359.	100.	543.	3956.
8	543.	2.00	272.	0.76	357.	1.80	1.	0.14	357.	100.	543.	4499.
9	543.	2.00	272.	0.76	356.	1.80	1.	0.17	355.	100.	543.	5042.
10	543.	2.00	272.	0.77	354.	1.80	1.	0.20	353.	100.	543.	5585.
11	605.	2.00	303.	0.86	352.	2.40	1.	0.23	351.	100.	605.	6190.
12	605.	2.00	303.	0.87	350.	2.40	1.	0.32	348.	100.	605.	6795.
13	605.	2.00	303.	0.88	347.	2.40	3.	0.89	344.	100.	605.	7400.
14	605.	2.00	303.	0.89	345.	2.40	4.	1.21	341.	100.	605.	8005.
15	605.	2.00	303.	0.90	342.	2.40	5.	1.54	337.	100.	605.	8610.
16	616.	2.00	308.	0.92	340.	3.40	6.	1.87	334.	100.	616.	9226.
17	616.	2.00	308.	0.94	337.	3.40	8.	2.26	329.	100.	616.	9842.
18	616.	2.00	308.	0.95	333.	3.40	9.	2.65	324.	100.	616.	10458.
19	616.	2.00	308.	0.96	330.	3.40	10.	3.01	320.	100.	616.	11074.
20	616.	2.00	308.	0.98	326.	3.40	11.	3.39	315.	100.	616.	11690.
21	616.	2.00	308.	0.99	323.	3.40	12.	3.76	311.	100.	616.	12306.
22	616.	2.00	308.	1.01	320.	3.40	13.	4.15	306.	100.	616.	12922.
23	616.	2.00	308.	1.02	316.	3.40	14.	4.54	302.	100.	616.	13538.
24	616.	2.00	308.	1.04	313.	3.40	15.	4.95	297.	100.	616.	14154.
25	616.	2.00	308.	1.05	309.	3.40	17.	5.36	293.	100.	616.	14770.
26	616.	2.00	308.	1.07	306.	4.00	18.	5.78	288.	100.	616.	15386.
27	616.	2.00	308.	1.09	302.	4.00	19.	6.22	283.	100.	616.	16002.
28	616.	2.00	308.	1.11	298.	4.00	20.	6.67	278.	100.	616.	16618.
29	616.	2.00	308.	1.13	294.	4.00	21.	7.13	273.	100.	616.	17234.
30	616.	2.00	308.	1.15	290.	4.00	22.	7.61	268.	100.	616.	17850.
31	668.	2.00	334.	1.27	286.	2.10	23.	8.10	263.	100.	668.	18518.
32	668.	2.00	334.	1.29	284.	2.10	25.	8.90	259.	100.	668.	19186.
33	668.	2.00	334.	1.31	282.	2.10	27.	9.71	254.	100.	668.	19854.
34	668.	2.00	334.	1.33	280.	2.10	29.	10.23	251.	100.	668.	20522.
35	668.	2.00	334.	1.35	278.	2.10	30.	10.76	248.	100.	668.	21190.
36	668.	2.00	334.	1.37	275.	2.10	31.	11.30	244.	100.	668.	21858.
37	668.	2.00	334.	1.39	273.	2.10	32.	11.85	241.	100.	668.	22526.
38	668.	2.00	334.	1.41	271.	2.10	34.	12.41	238.	100.	668.	23194.
39	668.	2.00	334.	1.43	269.	2.10	35.	12.97	234.	100.	668.	23862.
40	668.	2.00	334.	1.45	267.	2.10	36.	13.55	231.	100.	668.	24530.
41	668.	2.00	334.	1.47	265.	2.40	37.	14.13	228.	100.	668.	25198.

function?

EXHIBIT 26

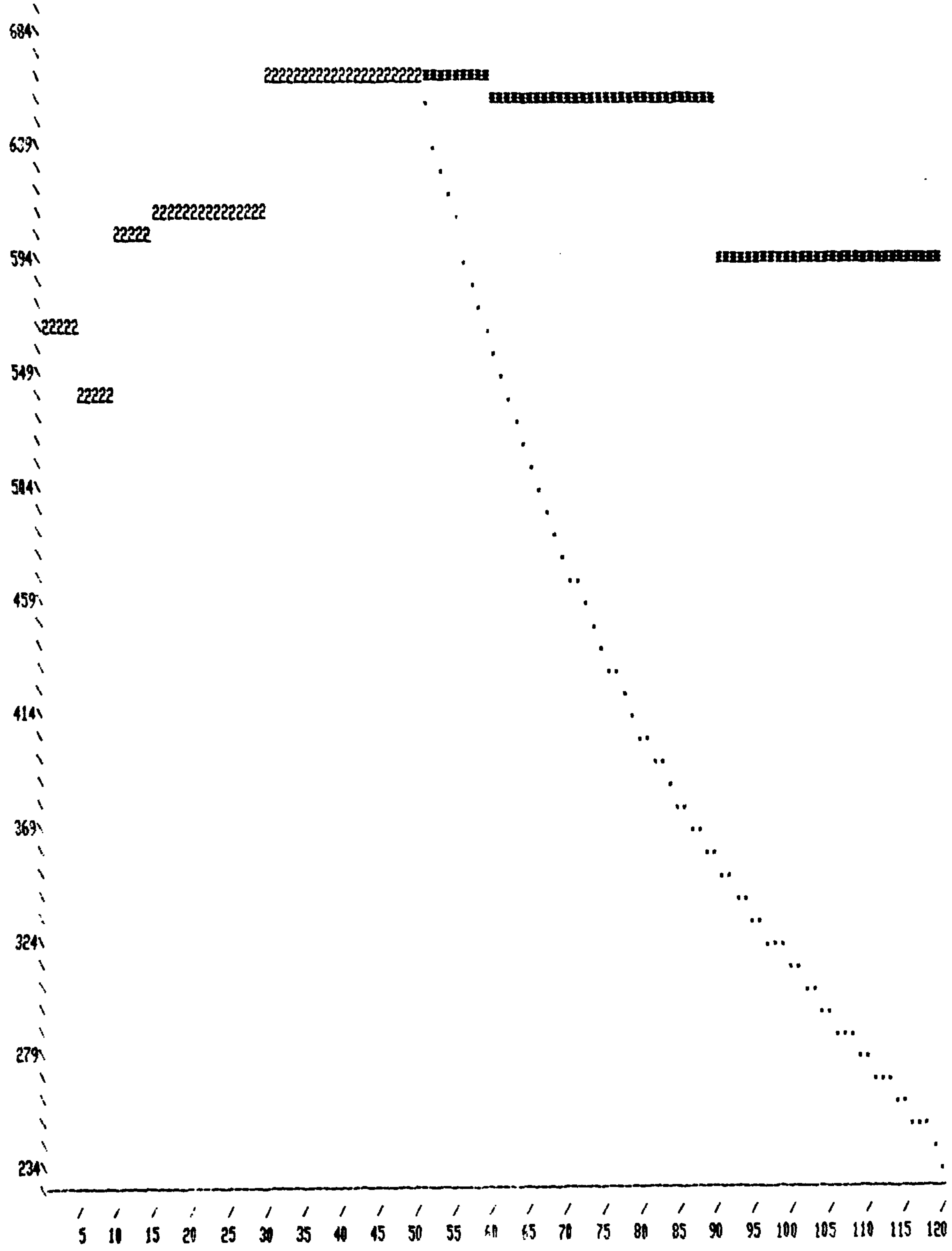


2 - MORE THAN ONE OBSERVATN
. - FLYABLE AIRCRAFT
% - PERCENT MISSIONS FLOWN
# - CANNIBALIZED AIRCRAFT
+ - ASSEMBLED AIRCRAFT

YEAR=1981 ATTRITION RATE USED: 0.0063 FOR MDS: XXXXX

EXHIBIT 27

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 13 PAGE 1
CAP LOG-XXX XX DON ZIMMERMAN   03/09/83   UNCLASSIFIED



2 - MORE THAN ONE OBSERVATN   * - MISSION REQUIREMENTS
. - MISSIONS ACCOMPLISHED

YEAR=1981   ATTRITION RATE USED: 0.0063   FOR MDS: XXXXX

EXHIBIT 28

SYNERGY, INC. OVERVIEW MODEL MISSION DEGRADATION MODULE   REPORT 15 PAGE 1
AF LOG-XXX XX DON ZIMMERMAN   03/09/83   UNCLASSIFIED

MASTER STOCK NUMBER	UNIT COST	UNIT REPAIR COST	ADMIN LEAD TIME	PROD LEAD TIME	BASE REPAIR TIME	DEPOT REPAIR TIME	ORDER + SHIP TIME	DEMAND RATE	BASE NRTS RATE	BASE COND. PCNT	DEPOT COND. PCNT	ITEM ESSEN. CODE	STOCK LEVEL	APPLICATIONS SYSTEM	APPLICATIONS AMOUNT
1430LLWW80460	2580.00	1109.00	3	21	0	81	15	0.000012	1.00	0.	0.02	1	0	XXXXX	1
1440LLWW83077	56870.00	24454.00	3	29	22	81	15	0.000084	0.29	0.	0.06	1	0	XXXXX	1
4820000011673	5260.00	2261.00	5	23	0	3	15	0.000143	1.00	0.	0.11	1	41	XXXXX	1
4820000011697	601.00	258.00	4	15	0	81	15	0.000012	1.00	0.	0.05	1	325	XXXXX	1
1680000011751	381.00	163.00	4	9	1	0	15	0.000024	0.	0.50	0.	1	16	XXXXX	2
1440000014601	2370.00	1019.00	2	20	16	81	15	0.000394	0.33	0.	0.16	1	92	XXXXX	5
4320000014611	2200.00	946.00	5	9	1	5	15	0.000251	0.95	0.	0.02	1	2	XXXXX	1
1680000019572	1850.00	795.00	5	15	7	0	15	0.000107	0.44	0.11	0.	1	43	XXXXX	2
1680000019574	168.00	72.00	5	9	5	0	15	0.000072	0.	0.	0.	1	35	XXXXX	2
1680000019576	236.00	101.00	5	9	6	0	15	0.000119	0.	0.	0.	1	68	XXXXX	2
1680000031470	350.00	150.00	7	11	0	81	15	0.000012	1.00	0.	0.06	1	13	XXXXX	1
1270000031558	2860.00	1229.00	5	6	19	81	15	0.000549	0.26	0.	0.02	1	33	XXXXX	14
1660000033732	599.00	257.00	3	9	7	0	15	0.000334	0.07	0.07	0.	1	17	XXXXX	1
1650000033733	838.00	360.00	5	8	25	0	15	0.000143	0.08	0.33	0.	1	221	XXXXX	1
1650000033821	3460.00	1487.00	1	32	42	81	15	0.000036	0.33	0.	0.01	1	19	XXXXX	1
6610000033957	3460.00	1487.00	5	8	1	3	15	0.000477	0.95	0.	0.03	1	51	XXXXX	1
6610000033958	4160.00	1788.00	5	8	0	3	15	0.000227	1.00	0.	0.02	1	37	XXXXX	1
6610000033959	24240.00	10423.00	5	12	2	3	15	0.000012	0.	0.	0.01	1	1	XXXXX	1
1660000036368	11730.00	5043.00	6	24	12	3	15	0.002984	0.11	0.	0.02	1	77	XXXXX	1
1680000036384	14590.00	6273.00	5	19	12	81	15	0.000024	0.	0.	0.10	1	0	XXXXX	1
1650000038886	9090.00	3908.00	6	17	12	81	15	0.000095	0.	0.	0.03	1	9	XXXXX	1
1660000038892	857.00	368.00	5	9	12	0	15	0.000191	0.19	0.	0.	1	18	XXXXX	1
1660000038904	1330.00	571.00	3	21	23	0	15	0.000382	0.06	0.06	0.	1	56	XXXXX	1
6625000039145	1810.00	778.00	3	29	3	3	15	0.000394	0.91	0.	0.03	1	96	XXXXX	1
5941000041236	573.00	246.00	2	7	1	81	15	0.000095	0.38	0.	0.09	1	216	XXXXX	1
1660000042834	1270.00	546.00	5	29	10	0	15	0.000692	0.03	0.02	0.	1	97	XXXXX	1
1730000043034	2660.00	1143.00	2	25	5	0	15	0.000072	0.33	0.33	0.	1	94	XXXXX	1
1560000043072	173710.00	74695.00	5	15	20	81	15	0.000024	0.50	0.	0.50	1	5	XXXXX	1
1377000044842	260.00	111.00	4	6	0	81	15	0.000024	1.00	0.	0.15	1	11	XXXXX	1
6340000044880	1410.00	606.00	5	15	1	81	15	0.000036	0.67	0.	0.01	1	2	XXXXX	1
6610000044964	347.00	149.00	5	7	5	3	15	0.000585	0.18	0.	0.05	1	32	XXXXX	2
6610000044967	451.00	193.00	3	15	5	3	15	0.002399	0.22	0.	0.05	1	117	XXXXX	2
1660000049697	1270.00	546.00	5	21	5	0	15	0.000310	0.04	0.04	0.	1	47	XXXXX	1
1680000049766	3990.00	1715.00	5	7	2	81	15	0.000239	0.90	0.	0.02	1	87	XXXXX	1
1660000049795	1300.00	559.00	4	9	3	3	15	0.000012	0.	0.	0.15	1	11	XXXXX	2
1377000050009	1760.00	756.00	4	19	0	81	15	0.000095	1.00	0.	0.02	1	12	XXXXX	2
5821000050287	563.00	242.00	5	3	2	81	15	0.000060	0.60	0.	0.01	1	396	XXXXX	1
1560000062090	1250.00	537.00	3	9	6	0	15	0.000298	0.16	0.04	0.	1	26	XXXXX	1
6610000062229	942.00	405.00	5	7	4	3	15	0.000143	0.33	0.	0.05	1	7	XXXXX	1
6610000062230	951.00	408.00	5	7	6	3	15	0.000251	0.48	0.	0.05	1	45	XXXXX	2
5921000062244	3490.00	1500.00	5	9	17	81	15	0.000298	0.08	0.	0.01	1	445	XXXXX	1
1430000064362	3450.00	1483.00	3	17	9										

function?

I. Model Results

1. Baseline Runs

This section contains the results of the effort undertaken to develop this Navy prototype capability assessment model. Therefore this section describes the methodology used in producing the model results. The Mission Degradation Module was run under various scenarios to test the model's ability to assess Navy mission capability and sustainability.

The model was exercised using UNCLASSIFIED sample Navy wartime and peacetime flying hour programs under various scenarios. The model was run for wars of 60 and 120 days using random levels of serviceable, unserviceable, and on-order assets with an assumed constant order and ship time of 15 days. In addition, the model was run under both the cannibalization and no cannibalization options. Immediately following is a brief report describing the results of each run and the levels of cannibalization necessary to achieve the sortie and flying hour requirements. Also specified are the expected mission losses if a no-cannibalization assumption is imposed. A summary of the model results is provided in Exhibit III-1. It is important to note that all the runs described below were made using the prototype 600 spare data base.

Run 1

The model was run under a scenario of 365 days of peace followed by a 60 day war with no cannibalization. The model predicts mission degradation will begin on Day 31 and rise steadily until it reaches 100 percent on Day 40 when there are zero flyable aircraft.

Run 2

The results of Run 2 were significantly different from Run 1. Again, the model was exercised under a scenario of 365 days of peace followed by a 60 day war, under the full cannibalization option. The model predicts the Navy's F-14As will be able to accomplish 100 percent of their mission during a 60 day war with full cannibalization.

Run 3

Run 3 was a scenario of 365 days of peace followed by a 120-day war with no cannibalization. The model results are exactly like those of Run 1. The model predicts that mission degradation will begin on Day 31 and rise steadily until it reaches 100 percent on Day 40 when there are zero flyable aircraft.

Run 4

Run 4, while similar to Run 2, extends the analysis beyond Day 60. Run 4 was made under a scenario of 365 days of peace followed by a 120-day war with full cannibalization. The model predicts the F-14A will be able to accomplish 100 percent of its missions until Day 67. On Day 67 mission degradation begins to rise steadily until it reaches a maximum where only 65 percent of the required sorties will be able to be flown.

EXHIBIT 29

SUMMARY, FØ14A MISSION DEGRADATION
BASELINE RUNS

RUN #	DAYS AT 100% CAPABILITY	DAY MISSION DEGRADATION REACHES A MAXIMUM	NMCS % LAST DAY OF WAR
1	30	40 (100%)	100%
2	60	60 (0%)	28%
3	30	40 (100%)	100%
4	66	120 (59%)	73%

2. Sensitivity Analysis

The purpose of the sensitivity analysis runs was to test the susceptibilty of the Mission Degradation Module to changes in flying hour requirements and sensitivity parameters such as inventory levels.

The methodology used to make these runs was similar to the baseline run methodology with the exception that the only changes made were either to flying hour requirements or to the inventory levels. The scenario was 365 days of peace followed by a 120 day war using serviceable, unserviceable and on-order assets for both the cannibalization and no cannibalization options. Immediately following is a brief report describing the results of each of the sensitivity analysis runs.

Run 5

Run 5 was run with a 20 percent increase in the inventory level with all the other parameters remaining constant under the no cannibalization option. The model predicts that 100 percent of the required mission can be flown until Day 31 when mission degradation begins. This is a similar result as the baseline case. The only difference is the model predicts that a 20 percent increase in assets will reduce the extent of mission degradation by 13 percent.

Run 6

Run 6 was also run with a 20 percent increase in inventory levels holding all other parameters constant but under the full cannibalization options. The model predicts that 100 percent of the required missions can be flown until Day 31 when mission degradation begins. The model predicts that a 20 percent increase in inventory levels combined with full cannibalization will give an increase of one day or 1 percent in capability at 100 percent of the required missions flown over the baseline case.

Run 7

Run 7 was run with a decrease of 20 percent in inventory levels without cannibalization and holding all other parameters constant. The model predicts that 100 percent of the required mission can be flown until Day 29. A loss of one day or 4 percent capability at 100 percent of required missions flown compared to the baseline case.

Run 8

Run 8 was also run with a 20 percent decrease in inventory levels but under the full cannibalization option. The model predicts that 100 percent of the required missions can be flown until Day 72 when mission degradation sets in. This is the exact same result as the baseline case which is not surprising because the cannibalization option compensates for this loss in assets. The model does predict that if assets by are decreased by 20 percent and cannibalize aircraft, the F-14A will only experience a loss of 1 percent capability compared to the baseline case.

Run 9

Run 9 was run with a 20 percent increase in flying hour requirements without cannibalization. The model predicts that 100 percent of the required missions can be flown until Day 26 when mission degradation sets in. This is a loss of 5 days or 17 percent in capability at 100 percent required missions flown when compared to the baseline case.

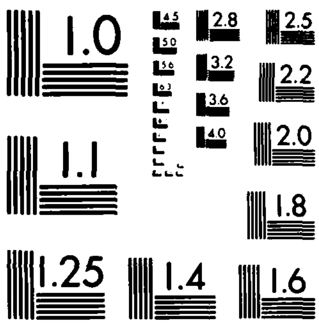
Run 10

Run 10 was also run with a 20 percent increase in the flying hour requirement but under the cannibalization option. The model predicts that 100 percent of the required flying hours can be flown until Day 61 when mission degradation begins. This is a loss of 11 days or 15 percent capability at 100 percent required missions flown when compared to the baseline case.

The results of this analysis suggest that the model is sufficiently sensitive to changes in flying hour requirements and inventory levels to give us confidence in the model's ability to perform comparative static analysis under various Navy scenarios.

AD-A145 005 DEVELOPMENT OF NAVY METHODOLOGIES FOR RELATING LOGISTICS RESOURCES TO MATERIEL READINESS(U) SYNERGY INC WASHINGTON DC D L ZIMMERMAN ET AL. 08 APR 84 2/3

UNCLASSIFIED MDA903-82-C-0243 F/G 15/5 NL



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

EXHIBIT 30

SUMMARY, FØ14A MISSION DEGRADATION
SENSITIVITY ANALYSIS RUNS

RUN #	DAYS AT 100% CAPABILTY	DAY MISSION DEGRADATION REACHES A MAXIMUM	NMCS% DAY 120
5	30	42 (100%)	100%
6	72	120 (58%)	72.7%
7	29	37 (100%)	100%
8	71	120 (58%)	73.3%
9	25	34 (100%)	100%
10	60	120 (67%)	75.1%

3. Logistics Capability Assessment Charts

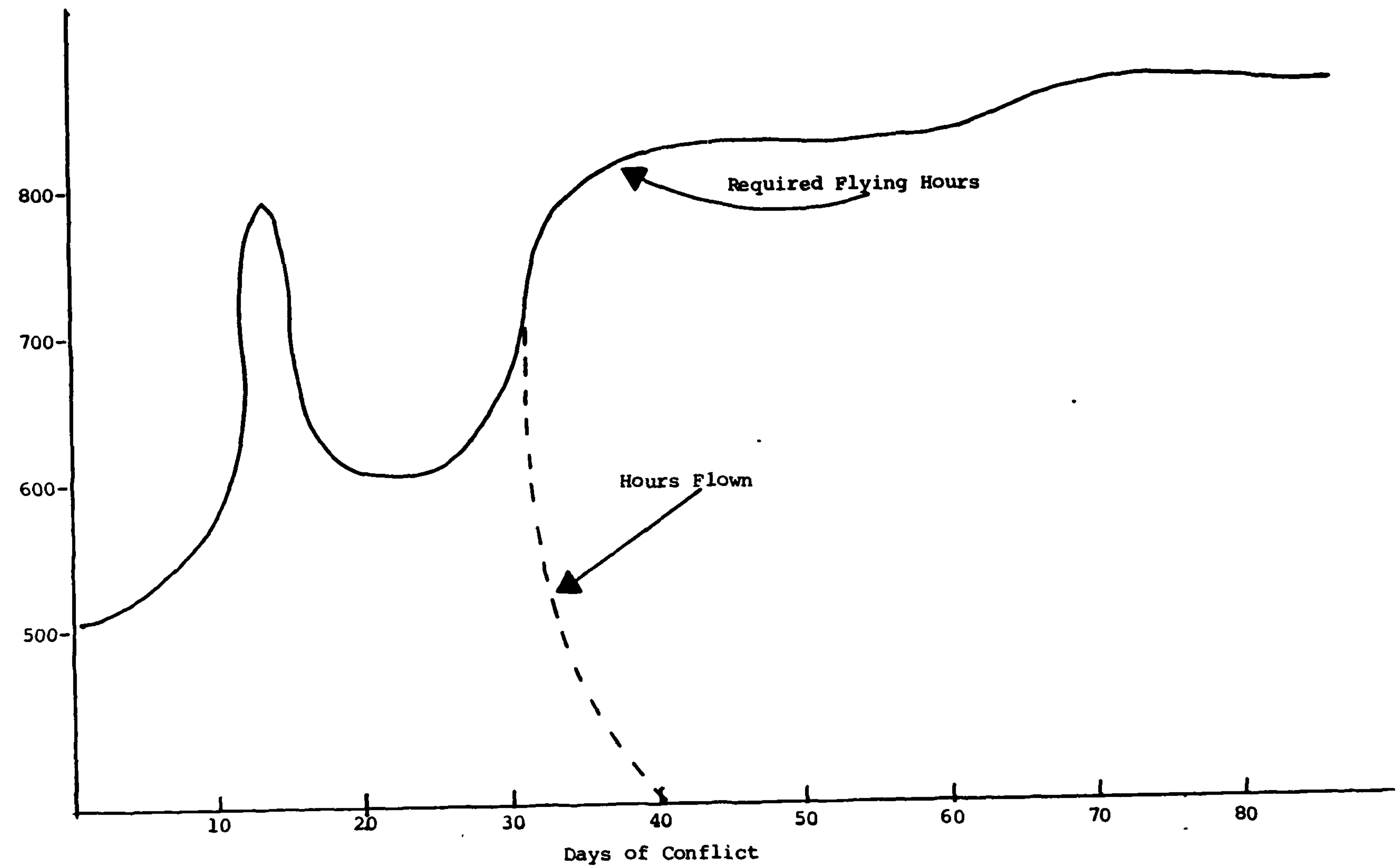
Logistics capability assessment charts can be derived from the results of the Mission Degradation Module. Exhibit III-3 is an unclassified F-14A prototype capability assessment chart based on the information provided by the Mission Degradation Analysis Report (Report 11).

Part 1 of the Mission Degradation Analysis Report gives the analyst day-by-day flying hour information which gives insights into the size and the shape of the required flying hour curve. In addition, Part 1 of the Mission Degradation Analysis Report shows day-by-day the actual hours the model predicts will be flown.

These two pieces of information, the required flying hour curve and the predicted actual hours flown curve, form the logistic capability assessment chart. This prototype logistics capability assessment chart shows the estimated mission capability and sustainability based on reparable spare parts availability. While the model at present only shows capability based on spare parts availability, it can be modified to show balanced capabilities based on the availability of other assets such as munitions and fuel.

EXHIBIT 31

(Unclassified)
F-14A CAPABILITY



4. Exercising the CAPLOG Model on the New Data Base

The model was exercised for a variety of scenarios and F-14 fleet sizes under varying assumptions of maximum turn rates, repair times and cannibalization options. In all, almost fifty model runs were made using various combinations of the following parameters:

Scenarios:	Peacetime, simulate SWA, simulate NATO
Fleet Sizes:	300 AC; 340 AC; 400 AC
Max Turn Rates:	1.0, 1.5; 2.0; 2.5
Cannibalization:	Full, None
Repair Times:	Reduced 50%; Actual, Increased 50%

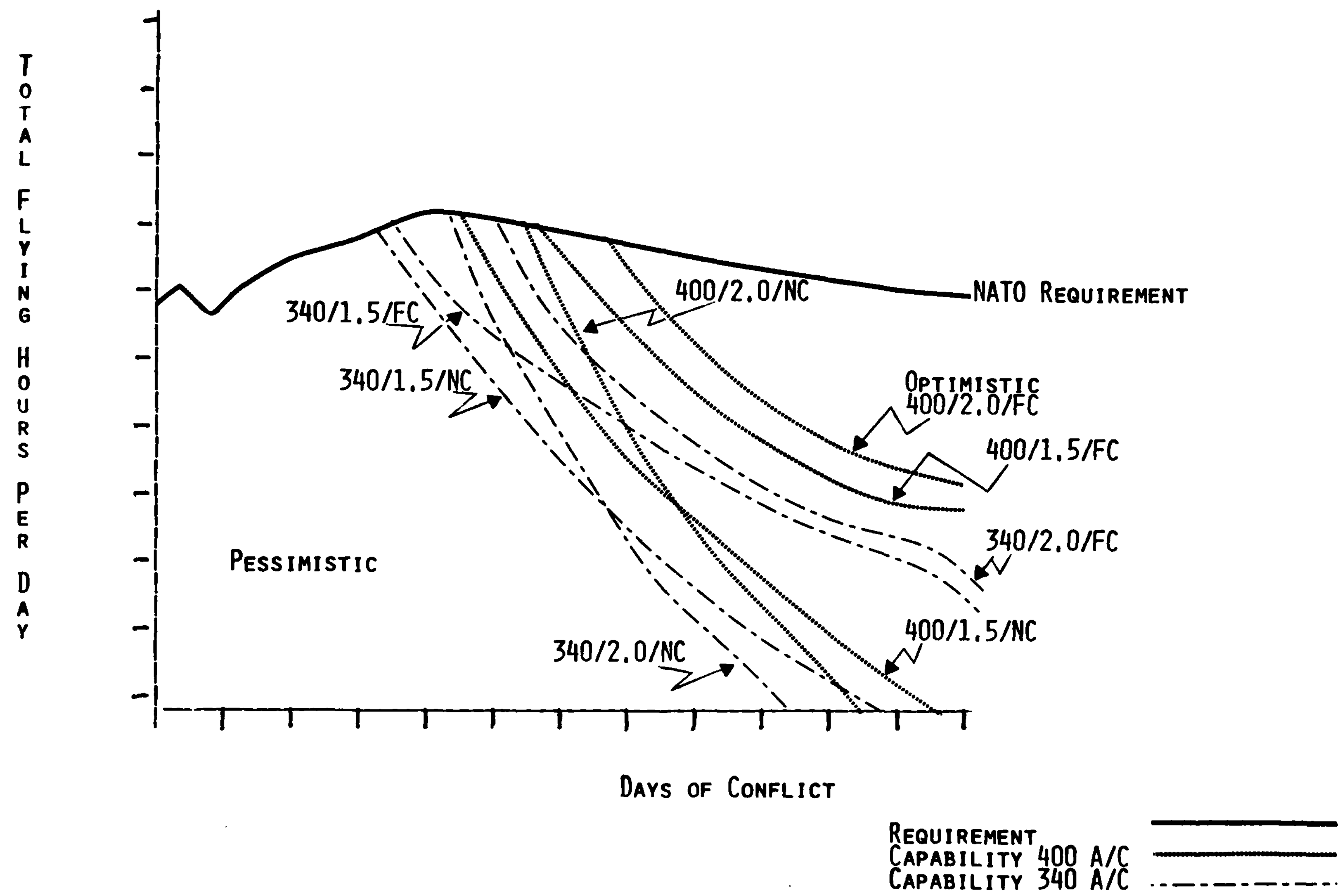
These outputs of the selected model runs are available on file. The most interesting set of runs consisted of the eight runs for the simulated NATO scenario consisting of the eight combinations of parameters given by:

Fleet Size:	340 AC, 400 AC
Max Turn Rate:	1.5, 2.0
Cannibalization:	Full, None

The results of these eight model runs were summarized in graphic form to portray the capability estimates relative to the requirement in a single chart. These results are displayed in Exhibit 32.

EXHIBIT 32

CAPLOG CAPABILITY ASSESSMENTS



The worst and best cases of these eight runs defined the pessimistic and optimistic extremes which were used to portray an estimated capability band relative to the requirement. This capability band was presented in a briefing to display representative current F-14 capability as estimated by CAPLOG. The entire briefing which contains this result is included in this report. The briefing slides are self-explanatory and are therefore presented without comment or text.

J. BRIEFING

NAVY LOGISTICS CAPABILITY ANALYSIS

******

CAPLOG

******

SPARES SUBSYSTEM DEVELOPMENT UPDATE

OUTLINE

-- Background and Objectives

-- Current Status

-- Current Results

-- Strengths and Weaknesses

-- Extensions of Work

CURRENT CONTRACT

- BACKGROUND
  - CONTRACT FORMALLY BEGAN MAY, 1982
  - JOINTLY SPONSORED BY NAVY (OP-04) AND OSD (MRA&L)

- OBJECTIVES

  TO DEVELOP FOR ONE AIRCRAFT

  - AUTOMATED PROTOTYPE SPARES SUSTAINABILITY MODULE
  - SUPORTING DATA BASE
  - "ROUGHLY RIGHT" RUN OF THE MODEL

MODEL DESIGN PARAMETERS

- Quick Turnaround (24 Hours)
- Allow "What-if" Questions and Judgmental Input by Users
  - Flying Programs
  - Spare Characteristics
  - Scenarios
- Focus on Wartime Capability Assessment
- Spare-Specific Calculations
- Use of Standard Navy Data
- Good Model and Data Documentation
  - Facilitate User Changes to Models
  - Evolutionary Expansion of Prototypes

CAPLOG MODEL METHODOLOGY

INPUT DATA ------------------>	MODEL LOGIC ---------------->	OUTPUTS

ASO & NAMSO ITEM DATA	• Determines
	  • Available Assets
		• Percent of Required Sorties
		  • By A/C Type
		  • By Day

Wartime Flying Hours	• Applies
	  • Failure Rates
	  • Wartime F/HR Programs
	• Computes
	  • Sorties Generated
	  • Aircraft Status
		• A/C Status By Day By A/C Type
		  • Unattrited Aircraft
		  • Cannibalized Aircraft
		  • NMCS Aircraft
		  • MC Aircraft

User-Defined Scenario Controls	• Identifies
	  • Item Shortages
	  • Related Costs
		• Item Results
		  • Critical Items By A/C Type
		  • Related Costs

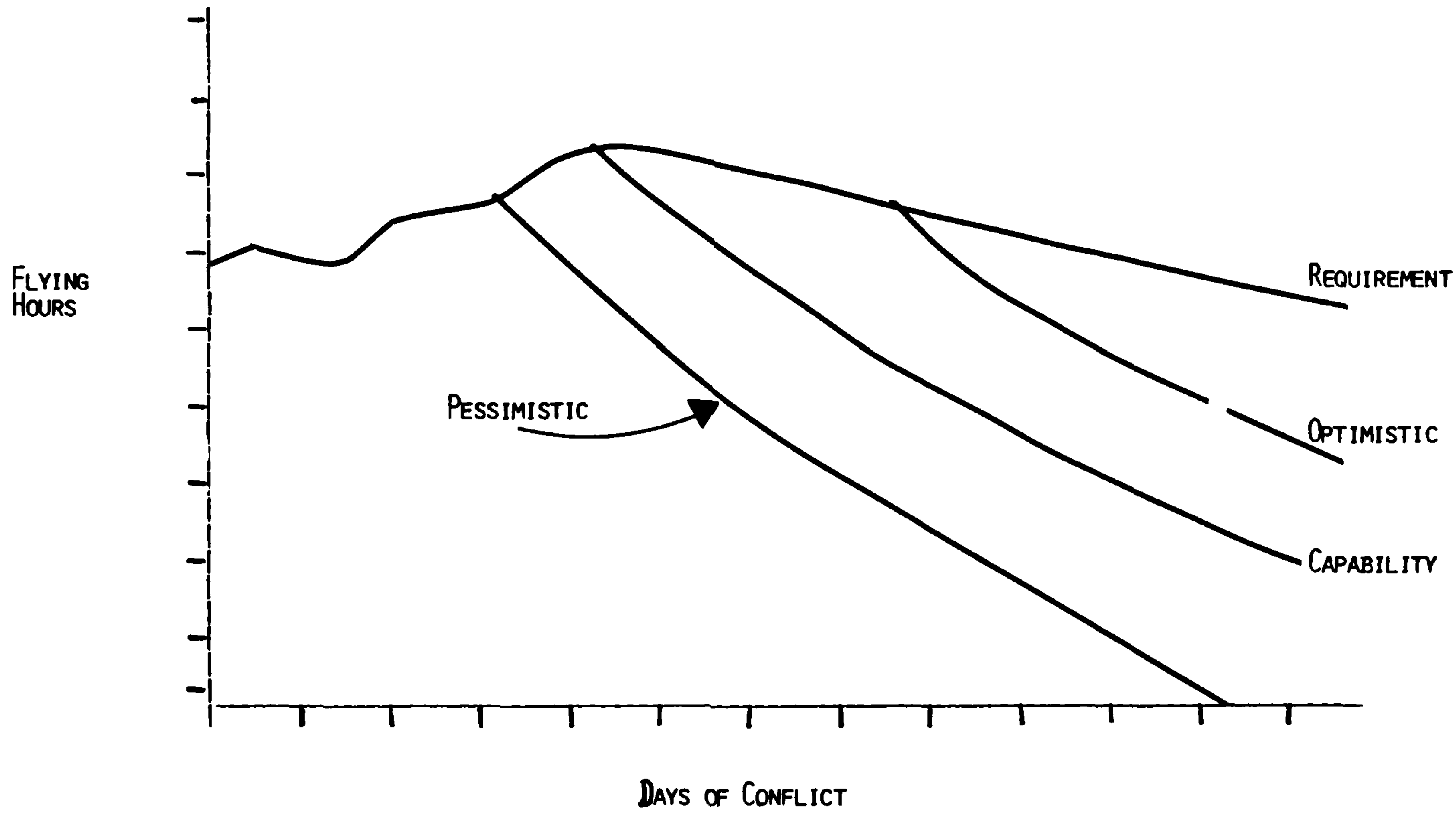
CURRENT STATUS

- MODEL UP AND RUNNING

- BASELINE RUNS
  - -- ONE AIRCRAFT - F-14A
  - -- FULL FY84 FORCE
  - -- 120-DAY WAR
  - -- ON-HAND AND ON-ORDER SPARES
  - -- CANNIBALIZATION ALLOWED

- WHAT IS OUR CURRENT CAPABILITY?

CAPLOG
CAPABILITY ASSESSMENT
SPARES CONSTRAINED



STRENGTHS AND WEAKNESSES

STRENGTHS	WEAKNESSES
-- OPERATIONALLY ORIENTED	-- DATA ISSUES
-- MACRO, YET ITEM-SPECIFIC	-- NON-LINKAGE TO ASO BUDGETS
-- "WHAT-IF" CAPABILITY	
-- RUNS QUICKLY, EASY TO USE	

CAVEATS

- ESTIMATE IS A USEFUL WORKING HYPOTHESIS
- SENSITIVITY ANALYSES NEEDED
- DATA BASE IMPROVEMENTS IMPORTANT

EXTENSIONS

- Link Explicitly to ASO Budgeting/POM

- Other Aircraft (A-6/A-7)

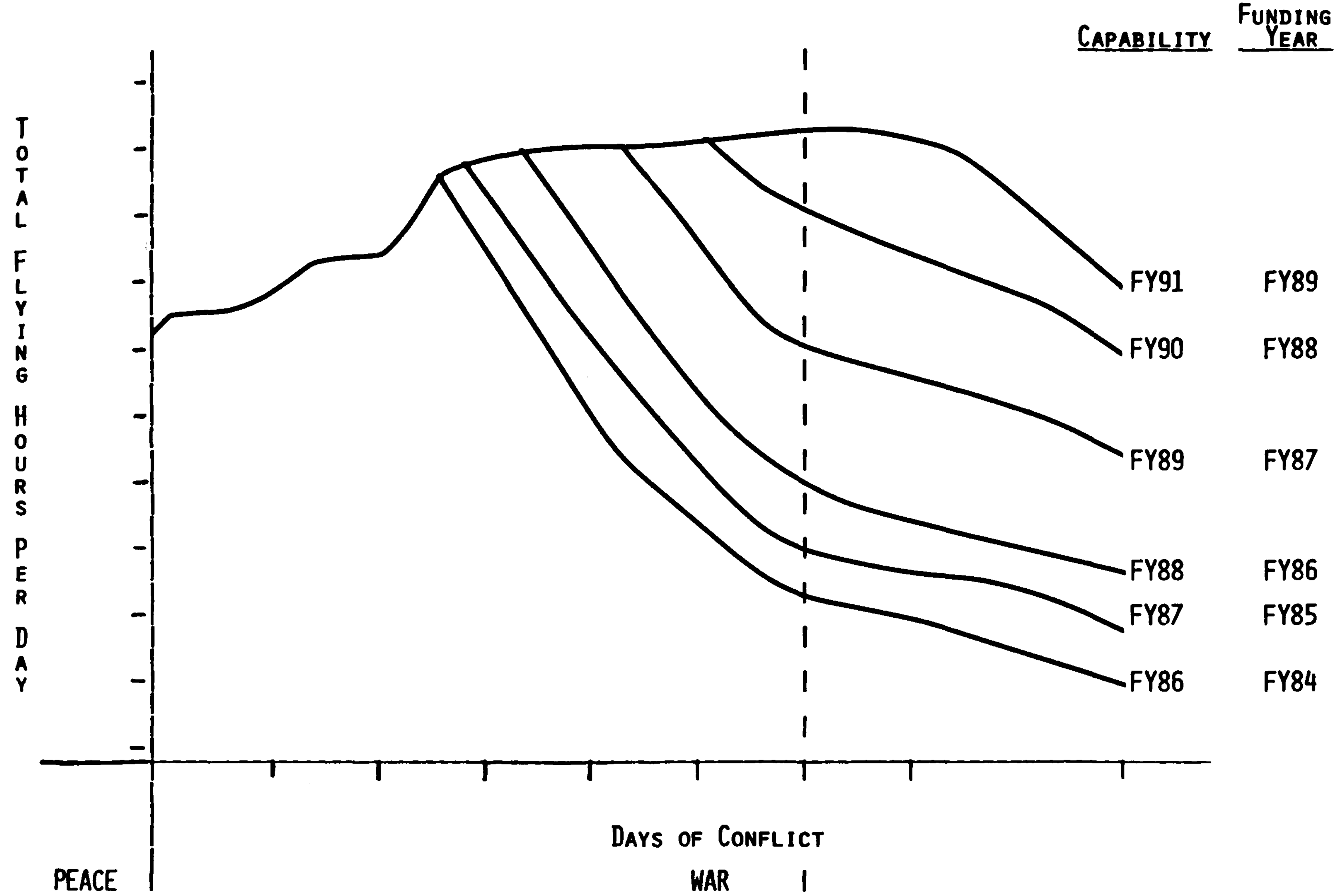
- Correlate with MC Projections

- Battle Group Analysis

  -- Single AVCAL Analysis with/without Resupply
  -- Synergistic Effects of 2 CV's

- Balanced Resourcing

CAPLOG
Capability Projections
Spares Constrained

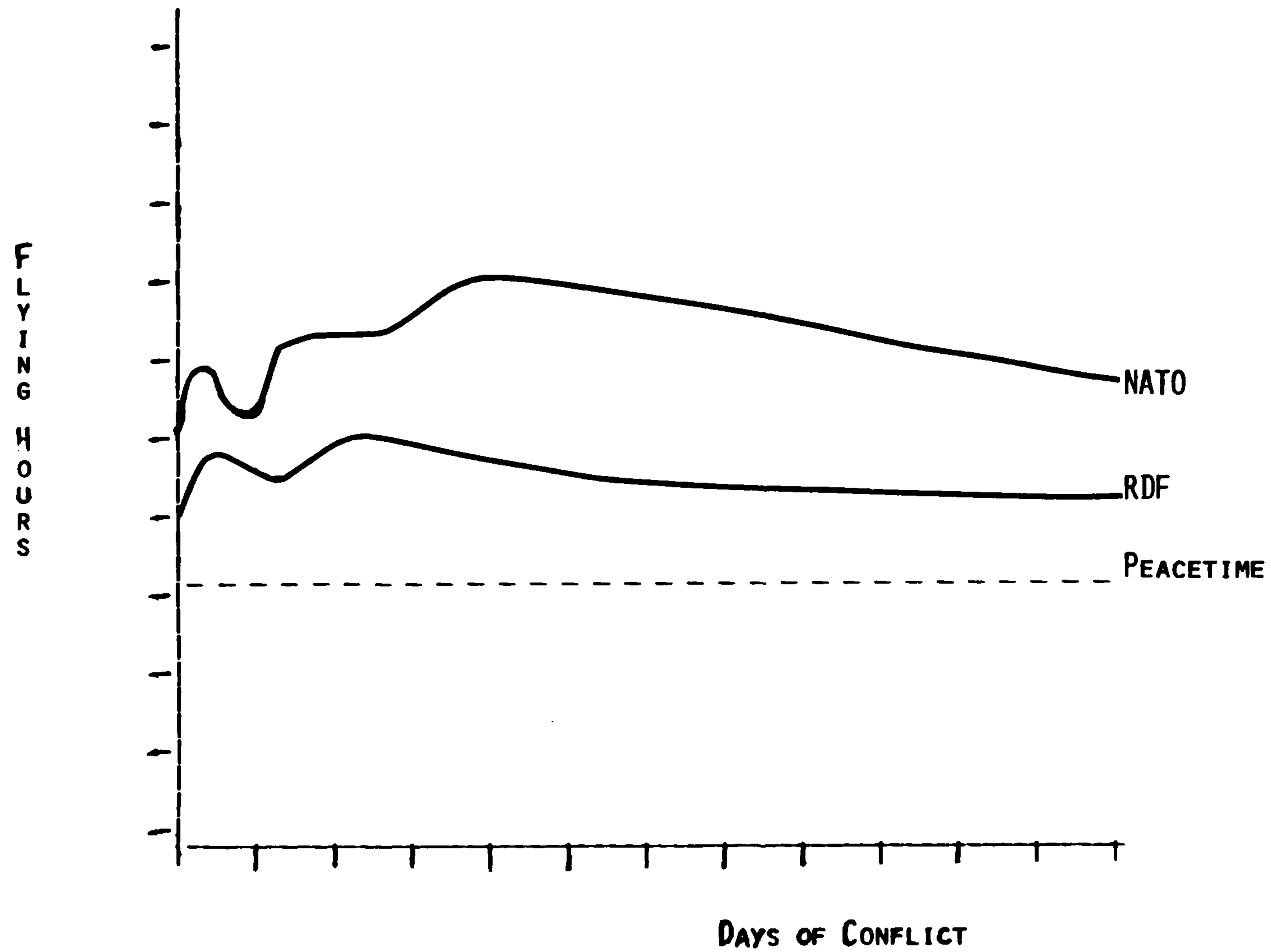


Assumption	Impact
- All Spares Mission Critical	Understates
- No Spare Transporation or Distribution Problems	Overstates
- Worldwide Asset Availability	Overstates
- No Asset Attrition	Overstates
- No Platform Attrition	Overstates
- Repair Times Remain at Peacetime Levels	Unclear

WARTIME FLYING HOUR PROFILE

INPUT	SOURCE
-- Employment	NNOR
-- Sortie Rates	NNOR
-- Attrition	NNOR

CAPLOG INPUTS
COMPARISON OF FLYING HOUR REQUIREMENTS



FLYING HOUR REQUIREMENTS

RANGE OF ASSUMPTIONS FOR CAPLOG MODEL RUNS

	Maximum Turns	Cannibalization	Aircraft Available
Pessimistic	1.50	No	340
Baseline	1.75	Partial	370
Optimistic	2.00	Yes	400

K. SOURCE LISTING

```
C       'CANNIBAL'  MISSION DEGRADATION MODEL
C
C-------------------------------------------------------------------
C FUNCTION:          THIS PROGRAM EVALUATES THE RELATIONSHIP BETWEEN
C                    INVENTORY INVESTMENTS AND MISSION CAPABILITIES.
C                    IT CALCULATES THE NUMBER OF AIRCRAFT AVAILABLE
C                    FOR MISSIONS AND NUMBER OF ASSEMBLED AIRCRAFT AS
C                    A FUNCTION OF TIME.
C
C STATUS:            MAIN PROGRAM
C
C LANGUAGE:          FORTRAN IV
C
C PRECISION:         SINGLE
C
C SUBROUTINES:       SETUP,  INPUT,  FLYHRS, ATTRAT, PLOTPT
C                    PAGE,   PESOPT, WAROPT, CRTSPR, REPT17
C
C NOTE:              SEE DOCUMENTATION FOR EXPLANATION OF VARIABLES.
C
C SYNERGY LABEL:     LA61A/FORTRAN/CANNIBAL
C
C LAST UPDATE:
C
C-------------------------------------------------------------------
      DOUBLE PRECISION NAME1,NAME2
      DIMENSION ATRATE(140,3),MAXMIS(140,3),MAXAC(141,3)
      DIMENSION ATTRIT(140,3),MPAC(360),CANNIB(360),PMF(360)
      DIMENSION AVLAC(140,3),MISFLN(140,3),MM(54),IPOINT(180)
      DIMENSION PARTSM(54),LIST1(86),IOUT(11),TABLEV(10)
      DIMENSION BASRET(361),DEPRET(361),MMCS(360)
      DIMENSION MSMC(3,3),IDAYC(54),ACMISS(360),HOURS(360)
      DIMENSION PLOTIN(1440),MARK(4),NAME1(4,4),NAME2(4,4)
      DIMENSION MDPT(54),RQ..TS(140),CAPABL(140)
      DI[illegible] MSNM(4,180),CRLIST(8,180)
C
      REAL      MAXMIS,MAXAC,MPAC,MISFLN,MM,MMCS
      LOGICAL   FIRSTI,PEACON,VARDEM,VARCAN,CRITIC,ENDFLG,CANBAL
      LOGICAL   FLAG11,FLAG12,FLAG13,FLAG14,FLAG15,FLAG16,FLAG17
      LOGICAL PACING
C
       COMMON   /FIXPLT/ PLTSWT,VALHI(10),VALLO(10)
      COMMON   /MISDEG/ RR(54),HRSDM(54),SL(54)
      COMMON   /BLOCKA/ IWFHDM(3,36),IPFHDY(200),NUMAC(200)
      COMMON   /BLOCKB/ IYR,JYR,TFH,PFH,INHOURS(36),AD,XDS,ADS,ABI,ADI,
     *                  APRI,BREPRP,BCONDP,BREPRM,BCONDM,DREPRP,DCONDP,
     *                  DREPRM,DCONDM
      COMMON   /BLOCKC/ MSN(4),COST,IALT,IPLT,IOST,DP,BP,BCP,DCP,OMBCP,
     *                  OMDCP,FR,URCOST,IDRT,IBRT,IIL,IILS,IILU,IILO,
     *                  NEWAR(10),IQPA(200)
C
C           NEWAR(1) = AY
C           NEWAR(2) = BY
C           NEWAR(3) = EY
C           NEWAR(4) = MEAN FAILURE RATE
C           NEWAR(5) = STANDARD DEVIATION OF FAILURE RATE
C
```

```
      COMMON   /BLOCKF/ FLAG11,FLAG12,FLAG13,FLAG14,FLAG15,FLAG16,FLAG17
      COMMON   /BLOCKG/ BELTA(40),RMIN(40),RMAX(40)
      COMMON   /BLOCKH/ JYEARS,IYEARS(9),JPDAYS(9),JMDAYS(9),JBUDGT(9)
      COMMON   /BLOCKL/ L1(1,70),L2(70),L3(70),LWORDS,LLENTH,LFREE
      COMMON   /BLOCKM/ M1(4,200),M2(200),M3(200),MWORDS,MLENTH,MFREE
      COMMON   /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT(50),LKOUNT(70)
C
      EQUIVALENCE (LIST1(1),MSM)
C
      DATA       IDAYC  /    54*361/
      DATA       RQMTS/  140*0.0/   CAPABL/   140*0.0/
      DATA       TABLEU /'  A','A-B','A-C','A-D','A-E',
     *                   'A-F','A-G','A-H','A-I','A-J'/
      DATA       CAMBAL  /   .FALSE./
      DATA       VARCAN  /   .FALSE./
      DATA       CRITIC  /   .FALSE./
      DATA       VARDEM  /   .FALSE./
      DATA       PEACON  /   .FALSE./
      DATA       PACING/.TRUE./
      DATA       NZERO   /          0/
      DATA       IPOINT  / 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12,13,14,15,
     *                   16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,
     *                   15*31,15*32,30*33,30*34,30*35,30*36/
      DATA       MARK    /1H*,1H.,1H+,1H%/
      DATA       NAME1   /'CANNIB','ALIZED',' AIRCR','AFT   ',
     *                   'FLYABL','E AIRC','RAFT  ','      ',
     *                   'ASSEMB','LED AI','RCRAFT','      ',
     *                   'PERCEN','T MISS','IONS F','LOWN  '/
       DATA      NAME2   /'MISSIO','N REQU','IREMEN','TS    ',
     *                   'MISSIO','NS ACC','OMPLIS','HED   ',
     *                   '      ','      ','      ','      ',
     *                   '      ','      ','      ','      '/
C-----------------------------------------------------------------
C     INITIALIZE DICTIONARIES AND WORK FILE.
C-----------------------------------------------------------------
      DO 10001 I=1,200
           NUMAC(I)=0
10001      CONTINUE
C
      CALL SETUP(.FALSE.)
      CALL INPUT(NUMMSN)
      MWORDS=NUMMDS + 32
      II    =1
      IO    =2
         DO 2 I=1,NUMMDS
            IPT=LSTMDS(I)
              DO 1 J=1,70
              DO 1 K=1,20
                   IF(MDXREF(J,K).EQ.IPT) GO TO 3
1             CONTINUE
3             MDPT(I)=J
2        CONTINUE
C
C          SET UP RANDOM DISK FILE
C
       CALL RANSIZ(25,140,)
       CALL RANSIZ(26,140,)
      IF(FLAG14)WRITE(14,814)
      IYR   =0
 10   IYR   =IYR + 1
```

```
      IPDAYS=JPDAYS(IYR)
      IWDAYS=JWDAYS(IYR)
      JYR   =IYEARS(IYR)
      IBUDGT=JBUDGT(IYR)
      IF(IWDAYS .GT. 120)IWDAYS=120
      IF(IYR .EQ. JYEARS)ENDFLG=.TRUE.
      CALL PAGE(06)
      WRITE(06,870)JYR,IPDAYS,IWDAYS
      NDAYS =IWDAYS
      CALL FLYHRS(.TRUE.,IPDAYS,IWDAYS)
C-------------------------------------------------------------
C         CALCULATE PARAMETERS FROM DATA CONTROL SECTION
C
C           DELTA(26)=HEROICS FRACTION
C           DELTA(24)=BATTLE DAMAGE RECOVERY FRACTION
C           DELTA(23)=PEACE TIME CONDEMNATION FRACTION
C           DELTA(21)=CRITICAL PART LIST SWITCH
C           DELTA(20)=CANNIBALIZATION FRACTION
C           DELTA(27)=VARIABLE DEMAND RATES FOR SELECTED PARTS
C           DELTA(31)=PLOT SCALE FIXING VARIABLE
C           DELTA(32)=AGGREGATING UP TO MD LEVEL
C           DELTA(33)=OUTPUTTING FLYING HOURS FOR PLOTTING
C           DELTA(34)=NUMBER OF AIRCRAFT MULTIPLIER
C           DELTA(35)=INVENTORY LEVEL MULTIPLIER
C-------------------------------------------------------------
C
C           CONVERT PERCENTAGES TO FRACTIONS
C
      DELTA(20)=DELTA(20) / 100.
      DELTA(23)=DELTA(23) / 100.
      DELTA(24)=DELTA(24) / 100.
      DELTA(25)=DELTA(25) / 100.
      DELTA(26)=DELTA(26) / 100.
      DELTA(34)=DELTA(34) / 100.
      DELTA(35)=DELTA(35) / 100.
C
C        CHECK MULTIPLIER/REDUCER FOR NUMBER OF AIRCRAFT
C                 AND NUMBER OF PARTS (INITIAL INVENTORY)
C
        IF(DELTA(34).LE.0.0) DELTA(34)=1.0
        IF(DELTA(35).LE.0.0) DELTA(35)=1.0
C
      FLTSWT=DELTA(31)
C
C      CONVERT HEROICS FRACTION TO THE RESULTING REDUCED REPAIR
C         FRACTION.
C
      DELTA(26)=1.-DELTA(26)
C
C     CONVERT PEACE TIME CONDEMNATION FRACTION TO FRACTION OF
C       NUMBER OF DAYS IN PEACE TIME YEAR SCENARIO
C
      DAYS=365.*DELTA(23)*IYR
       IF(DAYS.GT.0.) PEACON=.TRUE.
C
C      CHANGE ATTRITION REDUCTION(BATTLE DAMAGE REDUCTION) TO
C        RESULTING REDUCED ATTRITION
C
      BDR=1.-DELTA(24)
      IF(DELTA(21).GT.0) CRITIC=.TRUE.
        IF(DELTA(27).GT.0) VARDEM=.TRUE.
      IF(DELTA(20).GT.0.)  CANBAL=.TRUE.
       IF(CANBAL.AND.DELTA(20).LT.1.0) VARCAN=.TRUE.
```

```
C-----------------------------------------------------------------------
C     CALCULATE ATTRITION RATE AND DOWN TIME BY MDS
C-----------------------------------------------------------------------
      CALL ATTRAT(ATTRIT)
         IF(DELTA(32).LE.0.0) GO TO 6
C
C        INITIALIZE DISK FILES TO ZERO
C         DISK FILES HOLD MD AGREGATIONS
C
          DO 4 I=1,140
               RQMTS(I)=0.
               CAPABL(I)=0.0
4         CONTINUE
          DO 5 I=1,70
               WRITE(25'I) RQMTS
               WRITE(26'I) CAPABL
5         CONTINUE
6         CONTINUE
C-----------------------------------------------------------------------
C     WRITE HEADER ON REPORT 06
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C     GENERATE DAILY FLYING HOURS REQUIRED FOR EACH MDS
C     INITIALIZE MAXMIS,ATTRIT
C     INITIALIZE AVLAC,CANNIB,PMF,MPAC,MAXAC
C-----------------------------------------------------------------------
C     MAXMIS    MAXIMUM MISSIONS AVAILABLE BASED ON FH AND SORTIE LENGTH
C     MAXAC     MAXIMUM A/C AVAILABLE AFTER ATTRITION
C     AVLAC     NUMBER OF A/C WITH PARTS AVAILABLE FOR MISSIONS
C     BASRET    BASE RETURNS TO INVENTORY
C     DEPRET    DEPOT RETURNS TO INVENTORY
C     POH       PARTS ON HAND-CURRENT INVENTORY
C     ATTRIT    ATTRITION BASES ON MAXMIS
C     MPAC      MISSIONS PER AIRCRAFT BASED ON AVLAC AND MAXMIS
C     CANNIB    A/C CANNABALIZED IE,NOT ATTRITED BUT WITHOUT PARTS
C     PMF       PERCENT MISSIONS FLOWN BASED ON AVLAC AND MAXMIS
C     IPFHDY    FLEET PEACE TIME FLYING HOURS PER DAY
C     NUMAC     NUMBER OF AIRCRAFT AVAILABLE
C     SL        SORTIE LENGTH
C     MM        MAXIMUM MISSIONS PER AIRCRAFT PER DAY
C     MMIS      MAXIMUM MISSIONS PER FLEET PER DAY
C-----------------------------------------------------------------------
      DO 40 J=1,NUMMDS
           JJ    =LSTMDS(J)
C
C          INFLATE/DEFLATE NUMBER OF AIRCRAFT
C
          NUMAC(JJ)=NUMAC(JJ)*DELTA(34)
C
C       COMPUTE MAXIMUM SORTIES POSSIBLE PER DAY PER AIRCRAFT
C          BASED ON 24 HOUR DAY,DOWN TIME, AND SORTIE LENGTH
C
           MM    (J)=(24.0 - HRSDN(J)) / SL(J)
C
C      SET UPPER LIMIT ON FLYABLE AIRCRAFT
C
           MAXAC (1,J)=NUMAC(JJ)
          AVLAC(1,J)=NUMAC(JJ)
           DO 35 I=1,NDAYS
                NXTDAY=I + 1
                INDEX =IPOINT(I)
```

```
C
C       COMPUTE SORTIES REQUIRED BASED ON FLYING REQUIREMENTS
C           AND SORTIE LENGTH
C
                MAXMIS(I,J)=FLOAT(INFHBM(JJ,INDEX)) / SL(J)
                AMIS  =MN(J) * MAXAC(I,J)
C
C      MAXIMUM SORTIES POSSIBLE IS MINIMUM OF THE PER AIRCRAFT
C           RESTRICTIONS OR FLYING PROGRAM REQUIREMENTS
C
                IF(MAXMIS(I,J) .LT. AMIS) AMIS=MAXMIS(I,J)
C
C         ATTRITION RATE IS COMPUTED FOR LATER USE BY DIVIDING
C           NUMBER OF ATTRITED A/C (FROM ATTRAT SUBROUTINE) BY
C           NUMBERS OF SORTIES TO GET ATTRITION PER SORTIE.
C
                ATRATE(I,J)=ATTRIT(I,J)/AMIS
C
C        IF PROBLEM COMPUTING AMIS THEN SET ATTRITION RATE TO
C             PREVIOUS VALUE
C
      IF(AMIS.LE.0.) ATRATE(I,J)=ATRATE(I-1,J)
                MISFLN(I,J)=AMIS
C
C      UPPER LIMIT ON FLYABLE AIRCRAFT IS PREVIOUS DAY NUMBERS
C          MINUS PREVIOUS DAY ATTRITION
C
                MAXAC(NXTDAY,J)=MAXAC(I,J) - ATTRIT(I,J)
                IF(MAXAC(NXTDAY,J) .LT. 0.0)MAXAC(NXTDAY,J)=0.0
C
C   THIS IS VARIABLE UPPER LIMIT ON FLYABLE A/C INITIALIZED
C      WITH INITIAL NUMBERS OF A/C AND ATTRITION.MEANINGFUL
C      ONLY FOR FIRST DAY
C
                AVLAC(NXTDAY,J)=FLOAT(NUMAC(JJ)) - ATTRIT(I,J)
  35            CONTINUE
C        WRITE(11,3511) (ATRATE(I,J),ATTRIT(I,J),I=1,NDAYS,17)
3511            FORMAT(18F7.3)
40         CONTINUE
      CALL PAGE(11)
      WRITE(11,563)
563   FORMAT(' MSNS FOR WHICH THE PEACE TIME USAGE EXCEEDS INITIAL',
     1 ' INVENTORY LEVEL',/,'         LISTS IIL , TOTAL PEACE USAGE ,',
     1 ' PEACE CONDEMNATIONS , AND PEACE PIPELINE.',/,10X,
     3 'RESULTING IIL DECREASED BY 50%')
      CALL PAGE(06)
      IF(CRITIC) WRITE(6,562)
562   FORMAT('0MSN OF THE FIRST PART CAUSING FOLLOWING MDS TO HAVE',
     1 ' ZERO FLYABLE AIRCRAFT ON THAT GIVEN DAY',//,
     1   ' MSN              DAY       MDS')
C---------------------------------------------------------------------
C     MAIN LOOP OF PROGRAM
C     READ TEMPORARY FILE USED FOR DIFFERENT YEARS
C---------------------------------------------------------------------
      REWIND II
        NUMPTS=0
  50 READ(II,END=30)(LIST1(I),I=1,NWORDS)
C
C        INFLATE/DEFLATE INITIAL INVENTORY LEVEL
C
         IIL=IIL*DELTA(35)
```

```
      NUMPTS=NUMPTS+1
      IF(DELTA(27).EQ.0) GO TO 50001
      IF(DELTA(27).GT.0) GO TO 50010
      FR=FR-1.E-6*DELTA(27)*SQRT(1.E+6*FR)
      GO TO 50001
50010 IF(NEWAR(4).LT.99999.AND.NEWAR(5).LT.99999)
     1  FR=NEWAR(4)+DELTA(27)*NEWAR(5)
        FR=1.E-6*FR
50001 CONTINUE
C-----------------------------------------------------------------------
C     LOOK TO SEE IF THIS PART NEEDS TO BE PURCHASED TO INCREASE
C     INITIAL INVENTORY LEVEL
C-----------------------------------------------------------------------
C
C      COMPUTE BASE AND DEPOT REPAIR FRACTIONS AND CONDEMNATION
C                                                   FRACTION
C
      BASPCT=(1. - BCP) * (1. - DP)
      DEPPCT=(1. - BCP) * DP
      CONPCT=1.0-BASPCT-DEPPCT
C--------------------------------------------------------------------
C     COMPUTE DEPOT AND BASE REPAIR TIMES BASES ON HEROIC FRACTION
C            AND REPAIR TIME FRACTIONS FROM PARAMETERS
C--------------------------------------------------------------------
        DRTI=IDRT*DELTA(26)
        BRTI=IBRT*DELTA(26)
       IBRT=BRTI
       IDRT=DRTI
      TFAIL =0.
      TTBAS =0.
      TTDEP =0.
      TTCND =0.
      IPTS  =0
      DO 51 J=1,NUMNDS
   51       IPTS  =IPTS + IQPA(J) * NUMAC(LSTNDS(J))
      DBP   =FR * BASPCT
      DDP   =FR * DEPPCT
C-----------------------------------------------------------------------
C     COMPUTE BASE AND DEPOT RETURNS TO INVENTORY FROM PEACETIME
C-----------------------------------------------------------------------
      DO 51001 J=1,361
              BASRET(J)=0.0
              DEPRET(J)=0.0
51001         CONTINUE
C
       PECFAL=0.
       PP=0.
      DO 54 J=1,NUMNDS
            K     =IPFHBY(LSTNDS(J)) * IQPA(J)
C--------------------------------------------------------------------
C      ACCUMULATE TOTAL PEACE TIME PART FLYING HOURS
C--------------------------------------------------------------------
            IF(K .EQ. 0)GO TO 54
            X     =K * DBP
            Y     =K * DDP
            PECFAL = PECFAL + BCP*X + DCP*Y
            PP = IBRT*X + IDRT*Y
            DO 52 I=1,IBRT
                BASRET(I)=BASRET(I) + X
   52           CONTINUE
```

```
            DO 53 I=1,IDRT
                 DEPRET(I)=DEPRET(I) + Y
   53            CONTINUE
   54       CONTINUE
C------------------------------------------------------------------
C     CALCULATE INITIAL PARTS ON HAND
C     IPTS IS #A/C TIMES PARTS PER A/C TO GET TOTAL PARTS AVAILABLE
C     FOR CANNIBALIZING
C------------------------------------------------------------------
      POH = IIL
      IF(CANBAL)POH   =IIL + IPTS
C==============================================================
C        SUBTRACT OFF PEACE TIME CONDEMNATIONS
C--------------------------------------------------------------
        IF(.NOT.PEACON) GO TO 542
      TPF = PECFAL*DAYS
C
C     PRINT MESSAGE IF STARTING WAR IN THE HOLE
C
      IF(TPF.GT. POH) WRITE(11,541) MSN,POH,TPF,PECFAL,PP
541   FORMAT(1X,3A4,A3,4F10.1)
C-------------------------------------------------------------
C     APPLY A CORRECTION TO MAKE SURE YOU DONT RUN OUT BEFORE DAY 1
C--------------------------------------------------------------
       IF(TPF.GT. POH) TPF=0.5*POH
       POH = POH - TPF
542      IF(POH.LT.0.) POH=0.
          IF(CANBAL) GO TO 549
C
C     FOR NON-CANNIBALIZATION OPTION, SET TOTAL PARTS TO
C        INITIAL INVENTORY PARTS , SET FIRST TIME SWITCH , AND
C        INITIALIZE EACH MDS'S SPARE PARTS BUCKET TO ZERO.
C
          PARTS =POH
         FIRSTI=.TRUE.
         LASTMD=1
          DO 543 I=1,NUMMDS
543       PARTSM(I)=0
549        CONTINUE
C------------------------------------------------------------------
C     LOOP FOR NUMBER OF DAYS DURATION
C------------------------------------------------------------------
      DO 67 I=1,NDAYS
           NXTDAY=I + 1
           INDEX =IPOINT(I)
           IIBRT =I + IBRT
           IIDRT =I + IDRT
         IF(IIBRT.GT.361) IIBRT=361
         IF(IIDRT.GT.361) IIDRT=361
           BASRET(IIBRT)=0.0
           DEPRET(IIDRT)=0.0
           TTBAS =TTBAS + BASRET(I)
           TTDEP =TTDEP + DEPRET(I)
C------------------------------------------------------------------
C     ADD RETURNS-TO-INVENTORY (THOSE RETURNING ON THIS DAY
C     FROM IBRT OR IDRT DAYS AGO
C------------------------------------------------------------------
           PARTS=POH + BASRET(I) + DEPRET(I)
C
C   FOR N-C OPTION SAVE RETURNS TO INVENTORY FOR THIS DAY
C
```

```
      IF(.NOT.CANBAL) ADDIN= BASRET(I)+DEPRET(I)
         DO 66 J=1,NUMMDS
               IF(IQPA(J) .LE. 0)GO TO 66
               QPA   =IQPA(J)
        IF(CANBAL) GO TO 5499
C
C     CONSULT DOCUMENTATION FOR EXPLANATION OF FOLLOWING
C       CODE WHEREIN EACH MDS GETS ITS PARTS BUCKET SET UP FOR
C       EACH DAY BASED ON PREVIOUS STATUS OF BUCKET AND STATUS OF
C       BUCKET OF LAST MDS PROCESSED
C     TABLE IN DOCUMENTATION IS FOLLOWED
C
         IF(FIRSTI) GO TO 54981
      IF(PARTSM(LASTMD).LE.0.AND.PARTSM(J).LE.0) GO TO 5498
      IF(PARTSM(J).LE.0) GO TO 5497
      IF(PARTSM(LASTMD).LE.0) PARTSM(J)=0.
      IF(PARTSM(LASTMD).GT.0) PARTSM(J)=PARTSM(LASTMD)
       GO TO 5498
5497  PARTSM(J)=PARTSM(J)+PARTSM(LASTMD)
5498     PARTS=PARTSM(J)
C
C       USE RETURNS FROM INVENTORY ONLY ONCE THE FIRST TIME
C            THRU THE LOOP
C
54981   IF(ADDIN.GT.0.) PARTS=PARTS+ADDIN
        IF(ADDIN.GT.0.) ADDIN=0.
C     IF(I.LE.5.AND.NUMPTS.LE.5) WRITE(6,5491) I,J,PARTS,QPA,
C    1 MAXAC(I,J),AVLAC(I,J),MM(J),MAXMIS(I,J),MISFLN(I,J),
C    2 ATTRIT(I,J),ATRATE(I,J),SL(J)
5491  FORMAT(2I4,10F12.4)
5499           RMAXAC=MAXAC(I,J)
C-----------------------------------------------------------------
C    CALCULATE AVAILABLE A/C FROM PARTS ON HAND
C-----------------------------------------------------------------
               IF(CANBAL)GO TO 55
C
C     IN THE N-C MODE THE PARTS BUCKET CAN BE NEGATIVE SIGNIFYING
C         A/C GROUNDED DUE TO SHORATGE OF SPARES
C
               IF(PARTS .GE. 0.0)AVAC  =AVLAC(I,J)
               IF(PARTS .LT. 0.0)AVAC  =AVLAC(I,J) - ABS(PARTS / QPA)
               GO TO 56
   55          AVAC  =PARTS / QPA
C-----------------------------------------------------------------
C    MAKE SURE NOT BIGGER THAN MAXIMUM AVAILABLE A/C AFTER ATTRITION
C-----------------------------------------------------------------
   56          IF(AVAC .GT. RMAXAC)AVAC  =RMAXAC
C-----------------------------------------------------------------
C    MAKE SURE NOT NEGATIVE
C-----------------------------------------------------------------
               IF(AVAC .LT. 0.)AVAC  =0.
              IF(.NOT.CRITIC) GO TO 565
              IF(AVAC.GE.1.) GO TO 565
             IF(I.GE.IDAYC(J)) GO TO 565
             IDAYC(J)=I
             DO 569 K=1,3
569          MSNC(K,J)=MSN(K)
561           FORMAT(1X,3A4,A3,I5,2X,3A4,A3)
565     CONTINUE
               IF(AVAC .GE. AVLAC(I,J))GO TO 65
C-----------------------------------------------------------------
C    WRITE MSN TO OUTPUT FILE FOR INQUIRY
C-----------------------------------------------------------------
```

```
                IF(.NOT. FLAG14)GO TO 57
                WRITE(14,815)I,MSN,(M1(K,LSTMDS(J)),K=1,4),PARTS,
     *                   IQPA(J),RMAXAC,AVLAC(I,J),AVAC
   57           IF(.NOT. FLAG16)GO TO 59
                CALL IFETCH($58,MSN,M1,M2,M3,MWORDS,MLENTH,INDX)
                GO TO 59
   58           CALL ISTORE($59,MSN,M1,M2,M3,MWORDS,MLENTH,MFREE)
                WRITE(16,701)MSN
   59           AVLAC (I,J)=AVAC
C______________________________________________________________________
C     CAPTURE LAST CRITICAL PART.
C______________________________________________________________________
          IF(.NOT.PACING)GO TO 64
          DO 63 K=1,4
                MMSMN(K,I)=MSN(K)
   63           CONTINUE
          CRLIST(1,I)=IIL
          CRLIST(2,I)=PARTS
          CRLIST(3,I)=FR
          CRLIST(4,I)=BCP
          CRLIST(5,I)=DCP
          CRLIST(6,I)=IBRT
          CRLIST(7,I)=IDRT
          CRLIST(8,I)=DP
   64     CONTINUE
C----------------------------------------------------------------------
C     CALCULATE NEW ATTRITION, SORTIES FLOWN AND AVAILABLE A/C
C     BASED ON NEW MINIMUM PARTS AVAILABLE
C----------------------------------------------------------------------
                IF(MM(J) * AVAC .LT. MAXMIS(I,J))
     *                MISFLN(I,J)=MM(J) * AVAC
                ATTRIT(I,J)=ATRATE(I,J) * MISFLN(I,J)
                MAXAC(NXTDAY,J)=RMAXAC - ATTRIT(I,J)
   65           ATTR  =ATTRIT(I,J)
C----------------------------------------------------------------------
C     CALCULATE FAILURES (BUT NOT ON LOST A/C)
C----------------------------------------------------------------------
                FHPD  =(MISFLN(I,J) - ATTR) * SL(J)
                FAILUR=FR * FHPD * QPA
                TFAIL =TFAIL + FAILUR
C----------------------------------------------------------------------
C     CALCULATE BASE AND DEPOT RETURNS TO INVENTORY IN FUTURE
C----------------------------------------------------------------------
                BASRET(IIBRT)=FAILUR * BASPCT + BASRET(IIBRT)
                DEPRET(IIDRT)=FAILUR * DEPPCT + DEPRET(IIDRT)
C----------------------------------------------------------------------
C     CALCULATE NEW PARTS ON HAND
C----------------------------------------------------------------------
          IF(CANBAL) PARTS =PARTS - ATTR * QPA - FAILUR
C
C     IN N-C MODE ONLY FAILURES GET TAKEN OUT OF PARTS BUCKET
C
C     TURN OFF FIRST TIME THRU SWITCH
C
C      SAVE INDEX FOR USE AS 'LAST/PREVIOUS MDS'
C
       IF(.NOT.CANBAL) PARTSM(J)=PARTS-FAILUR
         FIRSTI=.FALSE.
        LASTMD=J
   66           CONTINUE
```

```
C-----------------------------------------------------------------
C     SAVE PARTS LEFT AFTER TODAY'S HAVOC FOR TOMORROW BEGINNING
C-----------------------------------------------------------------
          POH    =PARTS
   67     CONTINUE
C-----------------------------------------------------------------
C     ROUTINE TO CALCULATE NEW INITIAL INVENTORY FOR FUTURE YEARS
C-----------------------------------------------------------------
      IF(ENDFLG)GO TO 70
      NPEAS =PESOPT(IPDAYS,.FALSE.,0)
      IF(NPEAS .LE. IIL)GO TO 68
      IIL    =NPEAS
   68 NWAR   =WAROPT(IWDAYS,.FALSE.,0)
      IF(NWAR .LE. IIL)GO TO 69
      IIL    =NWAR
C-----------------------------------------------------------------
C     DECREASE CALCULATED INVENTORY BY PEACETIME FAILURES
C-----------------------------------------------------------------
   69 IIL    =IIL - NPEAS
C-----------------------------------------------------------------
C     WRITE NEW INVENTORY ON WORK FILE FOR NEXT YEAR'S PROCESSING
C-----------------------------------------------------------------
      WRITE(IO)(LIST1(I),I=1,NWORDS)
C-----------------------------------------------------------------
C     CALCULATE TOTAL COST AND TOTAL PARTS
C     CONDEMNATION FOR 100 BIGGEST THIEVES.
C-----------------------------------------------------------------
70       TTCND=TFAIL*(1.-BASPCT-DEPPCT)
         THIEF=TTCND*COST+(TTBAS/3.+TTDEP)*URCOST
        IF(INT(THIEF) .NE. 0)CALL CRTSPR(THIEF,TFAIL,TTBAS,TTDEP,TTCND)
        GO TO 50
C-----------------------------------------------------------------
C     CALCULATE CANNIBALIZED A/C,SORTIES PER A/C, % SORTIES FLOWN
C     AND MISSIONS ACCOMPLISHED(BASED ON FLYING PROGRAM)
C-----------------------------------------------------------------
80        CONTINUE
         IF(.NOT.CRITIC) GO TO 8002
           DO 8001 J=1,NUMNDS
           IF(IDAYC(J).GT.360) GO TO 8001
          WRITE(6,561)(MSNC(K,J),K=1,4),IDAYC(J),(NI(K,LSTNDS(J)),K=1,4)
8001      CONTINUE
8002  CALL PAGE(06)
      DIMENSION IIPPNT(180)
      DATA      IIPPNT  / 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12,13,14,15,
     *                   16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,
     *                   15*31,15*32,30*33,30*34,30*35,30*36/
      DO 11997 ITIT=1,180
11997       IPOINT(ITIT)=IIPPNT(ITIT)
      WRITE(06,810)JYR,TABLEV(INT(DELTA+17))
      DO 89 J=1,NUMNDS
            JJ    =LSTNDS(J)
            DO 82 I=1,NDAYS
                 PNF(I)=0.
                  MXTDAY=I + 1
                  INDEX =IPOINT(I)
                  HOURS(I)=IWFHDM(JJ,INDEX)
                  MAXAC(MXTDAY,J)=MAXAC(I,J) - ATTRIT(I,J)
C-----------------------------------------------------------------
C     CALCULATE CANNIBALIZED A/C
C-----------------------------------------------------------------
```

```
            MMCS(I)=MAXAC(I,J) - AV AC(I,J)
            IF(MMCS(I) .LT. 0.0)MMCS(I)=0.0
            IF(CANBAL)CANNIB(I)=MMCS(I)
            FMPAC =0.
            IF(AVLAC(I,J).GT.0.)FMPAC =MAXMIS(I,J)/AVLAC(I,J)
C-----------------------------------------------------------------------
C     CALCULATE SORTIES PER A/C
C-----------------------------------------------------------------------
            IF(FMPAC .GT. MM(J))FMPAC =MM(J)
            MPAC(I)=FMPAC
C-----------------------------------------------------------------------
C     CALCULATE PERCENT SORTIES FLOWN
C-----------------------------------------------------------------------
            PCNT  =0.0
            IF(MAXMIS(I,J) .GT. 0.0)PCNT  = 100. *
     *          MISFLN(I,J) / MAXMIS(I,J)
           IF(PCNT.GT.100.) PCNT=100.
            IF(PCNT .LE. 100.0)PMF(I)=PCNT
            ACMISS(I)=(PCNT / 100.0) * HOURS(I)
  82        CONTINUE
        IF(.NOT. FLAG11)GO TO 83
        CALL PAGE(11)
        WRITE(11,806)JYR,ATRATE(1,J),(M1(K,JJ),K=1,4)
        WRITE(11,804)
C-----------------------------------------------------------------------
C     PRINT OUTPUT REPORTS
C-----------------------------------------------------------------------
  83    CONTINUE
        DO 83001 I=1,11
              IOUT(I)=0
83001        CONTINUE
C
        CUMSUM=0.0
        DO 84 I=1,NDAYS
C-----------------------------------------------------------------------
C     MISFLN ARRAY WILL BE USED TEMPORARILY FOR 'PCT NMCS'
C-----------------------------------------------------------------------
            K     =NDAYS - I + 1
            MISFLN(I,J)=0.0
            RMAXAC=MAXAC(I,J)
            PERCNT=PMF(K)
            IF(RMAXAC .NE. 0)MISFLN(I,J)=(MMCS(I)/RMAXAC)*100.
            IF(PERCNT .LT. 100.0)IOUT( 1)=K
            IF(PERCNT .LT.  75.0)IOUT( 2)=K
            IF(PERCNT .LT.  50.0)IOUT( 3)=K
            IF(PERCNT .LT.  25.0)IOUT( 4)=K
            K     =INT(PMF(I) + .5)
            IF(I .EQ.  5)IOUT( 5)=K
            IF(I .EQ. 10)IOUT( 6)=K
            IF(I .EQ. 15)IOUT( 7)=K
            IF(I .EQ. 20)IOUT( 8)=K
            IF(I .EQ. 30)IOUT( 9)=K
            IF(I .EQ. 45)IOUT(10)=K
            IF(I .EQ. 60)IOUT(11)=K
C           IF(AVLAC(I,J).LT.1.) GO TO 85
            IF(.NOT. FLAG11)GO TO 84
            X     =PMF(I) * HOURS(I) * .01
            CUMSUM=CUMSUM + X
            WRITE(11,805)I,HOURS(I),SL(J),MAXMIS(I,J),
     *      MPAC(I),RMAXAC,ATTRIT(..),MMCS(I),
     *      MISFLN(I,J),AVLAC(I,J),PMF(I),X,CUMSUM
```

```
                 IF(I .NE. 55)GO TO 94
                 CALL PAGE(11)
                 WRITE(11,806)JYR,ATRATE(I,J),(M1(KK,JJ),KK=1,[illegible]
                 WRITE(11,804)
  94             CONTINUE
  95          IF(.NOT. FLAG12)GO TO 87
             DO 851 I=1,NDAYS
             PLOTIN(I)=CAMM1B(I)
             PLOTIN(NDAYS+I)=AVLAC(I,J)
             PLOTIN(NDAYS+NDAYS+I)=MAXAC(I,J)
851          PLOTIN(3*NDAYS+I)=PMF(I)
           CALL PLOTPT(4,IWDAYS,12,PLOTIN,MARK,NAME1)
           WRITE(12,806) JYR,ATRATE(1,J),(M1(KK,JJ),KK=1,4)
  87          IF(.NOT. FLAG13)GO TO 88
              IF(DELTA(32).NE.0.) GO TO 8711
                DO 871 I=1,NDAYS
                PLOTIN(I)=HOURS(I)
871             PLOTIN(I+NDAYS)=ACMISS(I)
             CALL PLOTPT(2,IWDAYS,13,PLOTIN,MARK,NAME2)
              WRITE(13,806)JYR,ATRATE(1,J),(M1(KK,JJ),KK=1,4)
C            WRITE OUT FLYING PROGRAM AND ACCOMPLISHMENTS FOR USE BY
C                   PLOTTING PROGRAM LATER.
C-----------------------------------------------------------------
            GO TO 88
8711       CONTINUE
         IREC=NDPT(J)
          READ(25'IREC) RQMTS
          READ(26'IREC) CAPABL
          DO 8720 I=1,NDAYS
                  RQMTS(I)=RQMTS(I)+HOURS(I)
                  CAPABL(I)=CAPABL(I)+ACMISS(I)
8720      CONTINUE
          WRITE(25'IREC) RQMTS
          WRITE(26'IREC) CAPABL
          GO TO 889
88            CONTINUE
          IF(DELTA(33).LE.0) GO TO 889
               WRITE(20,887) (M1(KK,JJ),KK=1,4),IWDAYS
887            FORMAT(3A4,A3,I5,20X,/,' REQUIRED FLYING HOURS AND ',
     1  'FLYING HOURS ACCOMPLISHED'.10X)
               WRITE(20,888) (HOURS(KK),ACMISS(KK),KK=1,IWDAYS)
888            FORMAT(2F12.0,56X)
C------------------------------------------------------------------------
C      WRITE REPORT 06
C------------------------------------------------------------------------
889           WRITE(06,811)(M1(K,JJ),K=1,2),IOUT
  89          CONTINUE
              CALL PAGE(06)
           INDX=(IWDAYS+19)/20
          WRITE(6,890) (I,I=1,IWDAYS,INDX)
890        FORMAT('0',20X,'LCMS OVERVIEW AIRCRAFT AVAILABILITY RESULTS',/,
     1  21X,'PERCENT ORIGINAL A/C AND PERCENT NON-ATTRITED A/C'
     1  ,//,
     1  '  MDS  ',20X,'WAR DAY',/,12X,20I6)
           DO 899 J=1,NUMMDS
                  DO 891 I=1,IWDAYS,INDX
891               PMF(I)=100.*AVLAC(I,J)/MAXAC(1,J)
                  WRITE(6,892) ([illegible] ,LSTMDS(J)),KK=1,[illegible]
                              (PM[illegible] I),I=1,IWDAYS,IN[illegible]
[illegible]        [illegible](1X,2A4,A3,20F[illegible])
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```
              DO 893 I=1,INDAYS,INDX
893                 PMF(I)=100.*AVLAC(I,J)/MAXAC(I,J)
              WRITE(6,894) (PMF(I),I=1,INDAYS,INDX)
894      FORMAT(12X,20F6.1)
899      CONTINUE
      IF(DELTA(32).LE.0) GO TO 8999
      IREC=0
      DO 8997 J=1,NUMMDS
      IF(IREC.EQ.MDPT(J)) GO TO 8997
      IREC=MDPT(J)
      READ(25'IREC) RQMTS
      READ(26'IREC) CAPABL
      DO 8991 I=1,NDAYS
              PLOTIN(I)=RQMTS(I)
8991          PLOTIN(I+NDAYS)=CAPABL(I)
        CALL PLOTPT(2,INDAYS,13,PLOTIN,MARK,NAME2)
        WRITE(13,8717) JYR,L1(1,IREC)
8717    FORMAT('0YEAR=',I4,'     MD= ',A6)
       IF(DELTA(33).LE.0) GO TO 8719
       WRITE(20,8718) L1(1,IREC),INDAYS
8718   FORMAT(A6,9X,I5,20X,/,' REQUIRED FLYING HOURS AND ',
     1        'FLYING HOURS ACCOMPLISHED',10X)
       WRITE(20,888) (PLOTIN(KK),PLOTIN(KK+INDAYS),KK=1,INDAYS)
8719    CONTINUE
8997      CONTINUE
8999      CONTINUE
C-----------------------------------------------------------------
C     PRINT CRITICAL PARTS LIST.
C-----------------------------------------------------------------
      IF(.NOT.PACING)GO TO 9500
      WRITE(18,884)
  884 FORMAT(1H1,' C R I T I C A L    P A R T S    L I S T;',/,
     * ' DAY  MASTER STOCK NO  INIT INV      POH   FL RATE      DC %',
     * '      DC %',
     * '         DRT       DRT      NRTS',/,
     * ' ___  ____________  _______  _______  ______  _______',
     * ' _______  _______',
     * '  _______  _______')
      DO 9050 I=1,NDAYS
       WRITE(18,885)I,(MMSNM(KK1,I),KK1=1,4),(CRLIST(KK2,I),KK2=1,8)
 9050       CONTINUE
  885 FORMAT(I4,1X,,4A4,2F10.0,F10.6,2F10.2,2F10.0,F10.2)
 9500 CONTINUE
C-----------------------------------------------------------------
C     PRINT 100 GREATEST THIEVES
C-----------------------------------------------------------------
      CALL CRTRPT
C-----------------------------------------------------------------
C   SWAP FILES TO USE NEW INITIAL INVENTORY FOR NEXT YEAR'S PROCESSING
C-----------------------------------------------------------------
   90 IF(ENDFLG)GO TO 99
      REWIND II
      REWIND IO
      II    =3 - II
      IO    =3 - IO
      GO TO 10
   99 WRITE(16,850)
      IF(FLAG17)CALL REPT17
      STOP
C-----------------------------------------------------------------
C     INPUT FORMATS
C-----------------------------------------------------------------
```

```
7?? FORMAT(3A4,A3)
7?? FORMAT(1X,I1,1X,2(I3,4X))
C-----------------------------------------------------------------
C     OUTPUT FORMATS
C-----------------------------------------------------------------
 804 FORMAT('0    REQUIRED                SORTIE RATE             ',
    *       '  LOST      NMCS                         PERCENT ',
    *       '                    ',/,
    *     '     FLYING    SORTIE    ---------------- ASSEMBLED',
    *       '    BY     UNFLYABLE   NMCS     FLYABLE  SORTIES ',
    *       '  HOURS   CUM HOURS',/,
    *     ' DAY   HOURS    LENGTH     FLEET   EACH ACFT AIRCRAFT ',
    *       ' ATTRITION AIRCRAFT  PERCENT  AIRCRAFT    FLOWN  ',
    *       '  FLOWN     FLOWN  ')
 805 FORMAT(I4,4(F10.0,F10.2),4F10.0)
 806 FORMAT('0YEAR=',I4,5X,'ATTRITION RATE USED:',F7.4,'   FOR MDS:',
    *  2X,3A4,A3)
 810 FORMAT('0',10X,'SUMMARY FOR ',I4,
    *       ' (SPARES WITH ESSENTIALITY CODES  ',A3,')',//,
    *18X,'DAY AT WHICH PERCENT           PERCENTAGE SORTIES',/,
    *18X,' SORTIES FLOWN REACH          FLOWN FOR VARIOUS',/,
    *18X,'  VARIOUS LEVELS                MISSION DAYS',/,
    *18X,'-------------------  ',35('-'),/,
    *18X,'  FIRST DAY BELOW               MISSION DAY',/,
    *18X,'-------------------  ',35('-'),/,
    *10X,'MDS     ',' 100%  75%  50%  25%     5   10   15   20   30',
    *   '   45   60',/,
    *10X,'------- ',' ---- ---- ---- ----  ',7(' ----'))
 811 FORMAT(10X,A4,A3,1X,4I5,2X,7I5)
 814 FORMAT('1PROBLEM SPARE REPORT')
 815 FORMAT(1X,I3,1X,3A4,A3,1X,3A4,A3,F16.2,I16,3F16.2)
 850 FORMAT('REWIND')
 870 FORMAT('0RUN CONTROL SECTION:',/,
    *     ' -------------------',//,
    *     ' YEAR              =',I7,/,
    *     ' PEACE DAYS        =',I7,/,
    *     ' WAR DAYS          =',I7)
     END
C     'ATTRAT'  INPUTS NUMBERS OF ATTRITED A/C
C
C
      SUBROUTINE ATTRAT(ATTRIT)
C
C       THIS SUBROUTING OBTAINS SORTIE LENGTHS,HOURS DOWN, AND
C       NUMBERS OF ATTRITTED A/C PER DAY
C
      DIMENSION MDS(4)
C
      COMMON   /MISDEG/ AR(54),HRSDN(54),SL(54)
      COMMON   /BLOCKN/ M1(4,200),M2(200),M3(200),MWORDS,MLENTH,MFREE
      COMMON   /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT(50),LKOUNT(70)
         INTEGER DAY(10)
         DIMENSION ATTRIT(140,3),VAL(12)
C
C          INITIALIZE HOURS DOWN AND SORTIE LENGTH
C          FOR ATTRITION RATE IS NOT USED
C
```

```
      DO 10 I=1,3
         AR    (I)=0.01
         HRSDN (I)=8.0
         SL    (I)=2.0
C
C     INITIALIZE NUMBERS OF ATTRITTED A/C TO ZERO
C
        DO 10 J=1,140
          ATTRIT(J,I)=0.0
   10    CONTINUE
C
C          READ IN AN MDS NAME,ATTRIT RATE,HOURS DOWN,SORTIE LENGTH
C
20       READ(09,701,END=90) MDS,X,Y,Z
C
C      LOOK UP MDS NAME   INDEX IS POINTER TO NAME
C
      CALL IFETCH($20,MDS,M1,M2,M3,MWORDS,MLENTH,INDEX)
      DO 30 I=1,NUMMDS
         IF(INDEX .EQ. LSTMDS(I))GO TO 40
   30    CONTINUE
      GO TO 20
40      CONTINUE
C
C       STORE ATTRIT RATE,HOURS DOWN,SORTIE LENGTH
C
          IF(X.GT.0.) AR(I)=X
          IF(Y.GT.0.) HRSDN(I)=Y
          IF(Z.GT.0.) SL(I)=Z
        GO TO 20
90      REWIND 09
C
C     READ IN MDS NAME AND 12 VALUES FOR NUMBERS OF ATTRITTED A/C
C     THE 12 VALUES ARE AGGREGATED NUMBERS OF ATTRITTED A/C AT THE
C     END OF DAYS 5,10,15,20,25,30,40,45,60,70,80,90
C
50      READ(19,702,END=95) MDS,VAL
702     FORMAT(3A4,A3,12F5.0)
        CALL IFETCH($50,MDS,M1,M2,M3,MWORDS,MLENTH,INDEX)
        DO 60 I=1,NUMMDS
         IF(INDEX .EQ. LSTMDS(I)) GO TO 70
60      CONTINUE
        GO TO 50
70      CONTINUE
          LOW=1
C
C     EXTRACT NUMBERS OF ATTRITTED A/C PER DAY BY GENERATING
C      DAYS FOR PERIODS AND DIVIDING BY LENGTH OF PERIOD,EITHER
C       5, 10, OR 15. SEE DOCUMENTATION
C
      DO 80 J=1,12
         IF(J .LT. 7)LIM  =5 * J
         IF(J .GT. 6)LIM  =(J - 3) * 10
         IF(J .EQ. 8)LIM  =45
         IF(J .GE. 12)LIM  =120
         IF(J .LE. 1)X    =VAL(J) / 5.0
         IF(J .GT. 1 .AND. J .LE. 6)X    =(VAL(J)-VAL(J-1)) / 5.0
         IF(J .GT. 6)X    =(VAL(J) - VAL(J - 1)) / 10.0
         IF(J .EQ. 8)X    =(VAL(J) - VAL(J - 1)) / 5.0
         IF(J .EQ. 9)X    =(VAL(J) - VAL(J - 1)) / 15.0
         DO 75 K=LOW,LIM
75          ATTRIT(K,I)=X
```

```
          LOW=LIM+1
 90     CONTINUE
        GO TO 50
 95     CONTINUE
        REWIND 19
      RETURN
 701  FORMAT(3A4,A3,3F6.2)
      END
C     'CRTSPR'  SORTS 100 BIGGEST THIEVES
C
C-----------------------------------------------------------------
      SUBROUTINE CRTSPR(THIEF,TFAIL,TTBAS,TTDEP,TTCND)
C
C       THIS SUBROUTINE IDENTIFIES SAVE , AND DISPLAYS
C       THE 100 BIGGEST THIEVES WITH RESPECT TO VARIOUS MEANS-
C        CONDEMNATION COST, BASE REPAIR COST, AND DEPOT REPAIR
C         COST AND THE TOTAL OF 3 COSTS
C
C
      DIMENSION THFCST(100),TOTFAL(100),TOTBAS(100),TOTDEP(100)
      DIMENSION REPBAS(100),MSNBAS(4,100),REPDEP(100),MSNDEP(4,100)
      DIMENSION CSTFAL(100),MSNFAL(4,100)
      DIMENSION CSTNUM(100),DEPNUM(100),BASNUM(100)
      DIMENSION TOTCND(100),ISTOCK(4,100)
C
      COMMON   /BLOCKC/ MSN(4),COST,IALT,IPLT,IOST,DP,BP,BCP,DCP,OMBCP,
     *                  OMDCP,FR,URCOST,IBRT,IDRT,IIL,IILS,IILU,IILO,
     *                  MEWVAR(10),IQPA(200)
C
       DATA THFCST/100*-1.0/,REPBAS/100*-1.0/,REPDEP/100*-1.0/
       DATA CSTFAL/100*-1.0/
          IF(THIEF.LE.THFCST(100)) GO TO 100
      DO 10 I=1,100
           IF(THIEF .GT. THFCST(I))GO TO 20
  10       CONTINUE
C
        GO TO 100
  20 M     =100 - I
     I     =100
     IF(M .EQ. 0)GO TO 40
     DO 30 J=1,M
           LAST  =I - 1
           THFCST(I)=THFCST(LAST)
           TOTFAL(I)=TOTFAL(LAST)
           TOTBAS(I)=TOTBAS(LAST)
           TOTDEP(I)=TOTDEP(LAST)
           TOTCND(I)=TOTCND(LAST)
           DO 25 K=1,4
                 ISTOCK(K,I)=ISTOCK(K,LAST)
  25             CONTINUE
           I     =LAST
  30       CONTINUE
  40 THFCST(I)=THIEF
     TOTFAL(I)=TFAIL
     TOTBAS(I)=TTBAS
     TOTDEP(I)=TTDEP
     TOTCND(I)=TTCND
     DO 45 K=1,4
           ISTOCK(K,I)=MSN(K)
  45       CONTINUE
 100   CONTINUE
```

```
      DRC=TTDEP*URCOST
      TFC=TTCND*COST
      BRC=TTBAS*URCOST/3.
      IF(BRC.LE.REPBAS(100)) GO TO 200
      DO 101 I=1,99
      IF(BRC.GT.REPBAS(I)) GO TO 120
101   CONTINUE
      GO TO 140
120   CONTINUE
      L=I+1
      DO 130 J=L,100
      N=100-J+L
      LAST=N-1
      REPBAS(N)=REPBAS(LAST)
      BASNUM(N)=BASNUM(LAST)
      DO 125 K=1,4
125       MSNBAS(K,N)=MSNBAS(K,LAST)
130   CONTINUE
140   REPBAS(I)=BRC
      BASNUM(I)=TTBAS
      DO 145 K=1,4
145   MSNBAS(K,I)=MSN(K)
200   IF(DRC.LE.REPDEP(100)) GO TO 300
      DO 210 I=1,99
      IF(DRC.GT.REPDEP(I)) GO TO 220
210   CONTINUE
      GO TO 240
220   CONTINUE
      L=I+1
      DO 230 J=L,100
          N=100-J+L
          LAST=N-1
          REPDEP(N)=REPDEP(LAST)
          DEPNUM(N)=DEPNUM(LAST)
          DO 225 K=1,4
225             MSNDEP(K,N)=MSNDEP(K,LAST)
230   CONTINUE
240   REPDEP(I)=DRC
      DEPNUM(I)=TTDEP
      DO 245 K=1,4
245       MSNDEP(K,I)=MSN(K)
300   IF(TFC.LE.CSTFAL(100)) RETURN
      DO 310 I=1,99
          IF(TFC.GT.CSTFAL(I)) GO TO 320
310   CONTINUE
      GO TO 340
320   CONTINUE
      L=I+1
      DO 330 J=L,100
      N=100-J+L
      LAST=N-1
          CSTFAL(N)=CSTFAL(LAST)
          CSTNUM(N)=CSTNUM(LAST)
          DO 325 K=1,4
325             MSNFAL(K,N)=MSNFAL(K,LAST)
330   CONTINUE
340   CSTFAL(I)=TFC
      CSTNUM(I)=TTCND
      DO 345 K=1,4
345       MSNFAL(K,I)=MSN(K)
      RETURN
```

```
      ENTRY CRTRPT
      CALL PAGE(06)
      WRITE(16,804)
      WRITE(06,801)
      DO 50 I=1,100
         IF(THFCST(I).LT.0.0)GO TO 50
         WRITE(06,802)I,(ISTOCK(J,I),J=1,4),THFCST(I),TOTFAL(I),
     *                 TOTBAS(I),TOTDEP(I),TOTCND(I)
         WRITE(16,803)(ISTOCK(J,I),J=1,4)
         IF(I .NE. 50)GO TO 50
         CALL PAGE(06)
         WRITE(06,801)
   50    CONTINUE
      CALL PAGE(06)
      WRITE(06,901)
901    FORMAT('0',15X,'BASE REPAIR COSTS/ 100 LARGEST ITEMS')
      WRITE(06,902)
902   FORMAT('0',4X,'MASTER STOCK NO       TOTAL COST        NUMBER')
      DO 60 I=1,100
      IF(REPBAS(I).LT.0.0)GO TO 60
      WRITE(06,802) I, (MSNBAS(K,I),K=1,4),REPBAS(I),BASNUM(I)
   60 CONTINUE
      CALL PAGE(06)
      WRITE(06,903)
903   FORMAT('0',15X,'DEPOT REPAIR COSTS/ 100 LARGEST ITEMS')
      WRITE(06,902)
      DO 70 I=1,100
      IF(REPDEP(I).LT.0.0)GO TO 70
       WRITE(06,802) I,(MSNDEP(K,I),K=1,4),REPDEP(I),DEPNUM(I)
   70 CONTINUE
      CALL PAGE(06)
      WRITE(06,904)
904    FORMAT('0',15X,'CONDEMNATION COSTS/ 100 LARGEST ITEMS')
      WRITE(06,902)
      DO 80 I=1,100
      IF(CSTFAL(I).LT.0.0)GO TO 80
       WRITE(06,802) I,(MSNFAL(K,I),K=1,4),CSTFAL(I),CSTNUM(I)
   80 CONTINUE
       RETURN
      ENTRY CRTCLR
      DO 600 I=1,100
         THFCST(I)=0.
         REPBAS(I)=0.
         REPDEP(I)=0.
         CSTFAL(I)=0.
          TOTFAL(I)=0.0
          TOTBAS(I)=0.0
          TOTDEP(I)=0.0
          TOTCNB(I)=0.0
  600     CONTINUE
      RETURN
  801 FORMAT('0',15X,
     *     ' REPARABLE SPARE MAINTAINABILITY AND RELIABILITY PRIORITY',
     *      ' ANALYSIS',//,
     *      5X,
     *      'MASTER STOCK NO      TOTAL COST        FAILURES',
     *      '       BASE REPS      DEPOT REPS      CONDEMNED',/,
     *      5X,6(1X,14('-')))
  802 FORMAT(1X,I3,1X,3A4,A3,5F15.0)
  803 FORMAT(3A4,A3)
  804 FORMAT('PAGE')
```

```
C      'PLOTPT'  PROVIDES LINE PRINTER PLOT OF UP TO 10 CURVES
C      -----------------------------------------------------
C
C----------------------------------------------------------------------
C
C FUNCTION:           THIS SUBROUTINE PLOTS TOTAL DEMANDS, TOTAL
C                     REQUIREMENTS AND PURCHASES OVER NO. OF WAR
C                     DAYS.
C
C STATUS:             SUBROUTINE
C
C LANGUAGE:           FORTRAN IV
C
C PRECISION:          SINGLE
C
C REQUIRED SUBROUTINES: PLOT
C
C LAST UPDATE:
C
C----------------------------------------------------------------------
C
      SUBROUTINE PLOTPT(LINES,N,IUNIT,X,MARK,NAME)
C
C      THIS SUBROUTINE WILL PLOT UP TO 10 CURVES WITH UP TO 360
C     VALUES PER CURVE
C
C         LINES IS THE NUMBER OF CURVES (UP TO 10)
C         N     IS THE NUMBER OF OBSERVATIONS PER CURVE (UP TO 360)
C         IUNIT IS FORTRAN UNIT NUMBER FOR WRITES
C         X     IS THE ARRAY OF OBSERVATIONS (PACKED , NO HOLES)
C         MARK  IS THE ARRAY OF CHARACTERS FOR PLOTTING EACH CURVE
C         NAME  IS THE DESCRIPTION FOR THE MARKS/CURVES (LEGEND)
C
      DOUBLE PRECISION NAME
      DIMENSION ISPOT(3600),ID(375),X(3600),MARK(10),NAME(4,10)
      DIMENSION Y(360),NUM(10)
       INTEGER TWO,SLASH
        EQUIVALENCE (NUM(3),TWO)
       LOGICAL XINTG,YINTG
C
      COMMON    /PLOTER/ HIGH,LOW,ALOWST,SCALE
        REAL LOW
C
      DATA      IBLANK  /       1H /
      DATA      ID      /   375*1H /
      DATA      LINS    /        52/
      DATA      NUM/1H0,1H1,1H2,1H3,1H4.1H5.1H6,1H7,1H8,1H9/
      DATA      SLASH/1H//
       XINTG=.TRUE.
       YINTG=.TRUE.
C
      N     =IABS(LINES)
      IF(LINES .EQ. 0)RETURN
      YLOW=0.
       YSCL=1.
       IF(N.GT.30.AND.N.LT.121) GO TO 4
       DO 3 I=1,N
       Y(I)=I
       CONTINUE
       CALL PLOT(Y,N,ISPOT,.FALSE.,120)
       YLOW=ALOWST
       YSCL=SCALE
```

```
4        CONTINUE
         I=YSCL
         XX=I
         IF(XX.NE.YSCL) YINTG=.FALSE.
      6 CALL PLOT(X,LINES*N,ISPOT,.FALSE.,52)
        CALL PAGE(IUNIT)
         I=SCALE
         XX=I
         IF(XX.NE.SCALE) XINTG=.FALSE.
          DO 7 I=1,120
7         ID(I)=IBLANK
        DO 50 I=1,LINS
             LC    =0
             DO 30 K=1,N
                  DO 20 J=1,N
         FL=(J-YLOW)/YSCL+0.9
         JL=FL
                       IF(ISPOT(J+(K-1)*N) .NE. I)GO TO 20
                      IF(ID(JL).EQ.MARK(K)) GO TO 19
                      IF(ID(JL).NE.IBLANK) ID(JL)=TWO
                       IF(ID(JL).EQ.IBLANK) ID(JL)=MARK(K)
19                     LC    =JL
20                     CONTINUE
30                CONTINUE
             IF(MOD(I+3,5) .NE. 0)GO TO 35
             XSP   =(52 - I) * SCALE + ALOWST
             ISP=XSP
         IF(.NOT.XINTG) WRITE(IUNIT,812) XSP,(ID(K),K=1,120)
             IF(XINTG) WRITE(IUNIT,802)ISP,(ID(K),K=1,120)
             GO TO 40
35           IF(LC .NE. 0)WRITE(IUNIT,803)(ID(K),K=1,120)
             IF(LC .EQ. 0)WRITE(IUNIT,803)
40           IF(LC .EQ. 0)GO TO 50
             DO 45 J=1,120
                  ID(J)=IBLANK
45                CONTINUE
50           CONTINUE
        WRITE(IUNIT,804)
         LL=5
         INC=5
         IF(N.GT.48) GO TO 90
         LL=1
         INC=1
90       CONTINUE
          DO 91 I=1,120
91        ID(I)=IBLANK
        DO 100 J=LL,N,INC
          FL=(J-YLOW)/YSCL+0.9
          JL=FL
100       ID(JL)=SLASH
        WRITE(IUNIT,807) (ID(I),I=1,120)
807     FORMAT(12X,120A1)
        DO 110 J=LL,N,INC
           FL=(J-YLOW)/YSCL+0.9
           JL=FL
           J1=J/100
           J2=J/10-10*(J/100)
           J3=J-10*(J/10)
           ID(JL)=NUM(J3+1)
           IF(JL.LT.2) GO TO 110
           IF(J1.GT.0.OR.J2.GT.0) ID(JL-1)=NUM(J2+1)
           IF(JL.LT.3) GO TO 110
```

```
      IF(JL.GT.0) ID(JL-2)=NUM(J+1)
110   CONTINUE
      WRITE(IUNIT,807) (ID(I),I=1,12)
      WRITE(IUNIT,806)((MARK(I),(NAME(J,I).J=1,4)),I=1,M)
812   FORMAT(1X,F10.3,'\',120A1)
802   FORMAT(1X,I10,'\',120A1)
803   FORMAT(11X,'\',120A1)
804   FORMAT(11X,'\',120('-')  )
815   FORMAT(12X,12I10)
805   FORMAT(12X,24I5)
806    FORMAT('0',15X,'2 - MORE THAN ONE OBSERVATN',10X,A1,' - ',4A6,/,
     1   16X,A1,' - ',4A6,9X,A1,' - ',4A6,/,16X,A1,' - ',4A6,9X,A1,
     2   ' - ',4A6,/,16X,A1,' - ',4A6,9X,A1,' - ',4A6,/,16X,A1,' - ',
     3   4A6,9X,A1,' - ',4A6,/,16X,A1,' - ',4A6)
      RETURN
       END
C      'PLOT  '  COMPUTES MIN, MAX, AND FILLS ARRAYS FOR PLOTPT
C      ----------------------------------------------------
C
C---------------------------------------------------------------
C
C FUNCTION:              THIS SUBROUTINE COMPUTES MIN, MAX, AND FILLS
C                        ARRAYS OF TOTAL DEMAND, TOTAL REQUIREMENT AND
C                        PURCHASES, FOR 'PLOTPT'.
C
C STATUS:                SUBROUTINE
C
C LANGUAGE:              FORTRAN IV
C
C PRECISION:             SINGLE
C
C REQUIRED SUBROUTINES: WRTROW
C
C LAST UPDATE:
C
C---------------------------------------------------------------
C
      SUBROUTINE PLOT(X,N,ISPOT,SORT,LAST)
      COMMON    /PLOTER/ HIGH,LOW,ALOWST,SCALE
       COMMON    /FIXPLT/ SWITCH,HIGHV(10).VLOW(10)
        REAL LOW
      DIMENSION ISPOT(N),X(N)
      LOGICAL SORT
         IF(SWITCH.LE.0.OR.SWITCH.GT.10) GO TO 5
                LOW=VLOW(SWITCH)
                HIGH=HIGHV(SWITCH)
         GO TO 30
5     LOW=X(N)
      HIGH=X(1)
      IF(SORT) GO TO 30
      LOW=X(1)
      DO 10 I=2,N
      IF(LOW.GT.X(I)) LOW=X(I)
      IF(HIGH.LT.X(I)) HIGH=X(I)
10    CONTINUE
 30   CONTINUE
       IPOWER=0
      IF(HIGH.LE.LOW) RETURN
      SCALE=(HIGH-LOW)/LAST
      RANGE=ALOG10(SCALE)
      IPOWER=RANGE
```

```
      IF(RANGE.LT.0) IPOWER=IPOWER-1
      SCALE=10.D0**(RANGE-IPOWER)
31      CONTINUE
      FSCALE=AINT(SCALE + 0.99)
      IF(SCALE.GT.1.0.AND.SCALE.LT.1.5) FSCALE=1.5
      IF(SCALE.GT.2.0.AND.SCALE.LT.2.5) FSCALE=2.5
32    SCALE=10.D0**(IPOWER)*FSCALE
      I=LOW/SCALE
      IF(LOW.LT.0.D0) I=I-1
      ALOWST=I*SCALE
        IF(LOW.EQ.1..AND.SCALE.LE.1.) ALOWST=0.
      IF((HIGH-ALOWST)/SCALE.LE.LAST) GO TO 39
      FSCALE=FSCALE+1
      IF(FSCALE.GT.3.5.AND.FSCALE.LE.10) GO TO 32
      IF(FSCALE.LE.3.5) GO TO 33
      FSCALE=1.5
      IPOWER=IPOWER+1
      IF(RANGE.LT.0) IPOWER=IPOWER-2
      GO TO 32
33    FSCALE=FSCALE-0.5
      GO TO 32
39    DO 40 I=1,N
      SP=(X(I)-ALOWST)/SCALE
40    ISPOT(I)=LAST-IFIX(SP)
      RETURN
      END
      BLOCK DATA
      COMMON /FIXPLT/ SWITCH,HIGHV(10),VLOW(10)
      DATA SWITCH/0/
      DATA VLOW/10*0./
      DATA HIGHV/100.,500.,1000.,5000.,10000.,50000.,100000.,500000.,
     1 1000000.,5000000./
      END
C        'SETUP '  INITIALIZES OVERVIEW MODULES
C
C-----------------------------------------------------------------
C
C FUNCTION:              THIS SUBROUTINE SETS UP THE NECESSARY
C                        DICTIONARIES FOR USE BY ANY OF THE OVERVIEW
C                        MODULES.  IT CREATES DICTIONARIES FOR
C                        (1) FEDERAL SUPPLY GROUPS, (2) FEDERAL SUPPLY
C                        CLASSES, (3) MISSION DESIGN (MD) WEAPON
C                        SYSTEMS, AND (4) MISSION DESIGN SERIES (MDS)
C                        WEAPON SYSTEMS.  IT ALSO CREATES THE CROSS
C                        REFERENCE TABLES THAT RELATE FSC'S TO FSG'S
C                        AND MDS'S TO MD'S.  OPTIONAL REPORT FLAGS ARE
C                        SET. USER SELECTED FSC'S, MDS'S, AND ALC'S ARE
C                        READ IN AND VERIFIED.
C
C LANGUAGE:              FORTRAN IV
C
C REQUIRED SUBROUTINES:  HEDDA, STORTV, ISTORE, IFETCH, PAGE
C
C VARIABLES:             ITEM            TEMPORARY BUFFER FOR INPUT
C                        TITLE           TEMPORARY BUFFER FOR INPUT
C                        JTITLE          BANNER PAGE
C                        IDATE1          D041 ASSET CUT-OFF DATE
C                        IDATE2          JOB SUBMISSION DATE
C                        INAME           JOB SUBMITTER
C                        FLAG            ..PRESS PRINT FLAG
C                        MODULE          : - OVERVIEW
```

```
C                                2 - MISSION DEGRADATION
C                                3 - PIPELINE FILL
C                                4 - READINESS
C                ICLASS          1 - UNCLASSIFIED
C                                2 - FOR OFFICIAL USE ONLY
C                                3 - CLASSIFIED(CONFIDENTIAL)
C                                4 - CLASSIFIED(SECRET)
C                                5 - CLASSIFIED(TOP SECRET)
C                FLAGS          OPTIONAL REPORT SWITCHES
C                JYEARS         NUMBER OF YEARS TO RUN
C                IYEARS         FISCAL YEARS (E.G. 1981, 1982)
C                IPDAYS         PEACE DAYS TO RUN EACH YEAR
C                IWDAYS         WAR DAYS TO RUN EACH YEAR
C                IBUDGT         BUDGET CONSTRAINTS EACH YEAR
C                J1,J2,J3       FSG DICTIONARY TABLES
C                K1,K2,K3       FSC DICTIONARY TABLES
C                L1,L2,L3       MD  DICTIONARY TABLES
C                M1,M2,M3       MDS DICTIONARY TABLES
C                JCOUNT         FSG DICTIONARY ENTRY COUNT
C                KCOUNT         FSC DICTIONARY ENTRY COUNT
C                LCOUNT         MD  DICTIONARY ENTRY COUNT
C                MCOUNT         MDS DICTIONARY ENTRY COUNT
C                JKOUNT         NUMBER OF FSC'S IN EACH FSG
C                LKOUNT         NUMBER OF MDS'S IN EACH MD
C                IFXREF         FSC TO FSG CROSS REFERENCE TABLE
C                MDXREF         MDS TO MD CROSS REFERENCE TABLE
C                NUMFSC         # OF FSC'S TO BE USED IN A RUN
C                NUMMDS         # OF MDS'S TO BE USED IN A RUN
C                NUMALC         # OF ALC'S TO BE USED IN A RUN
C                LSTFSC         INDICES OF FSC'S FROM K1 TO
C                               BE USED IN A RUN
C                LSTMDS         INDICES OF MDS'S FROM M1 TO
C                               BE USED IN A RUN
C                LSTALC         ALC'S TO BE USED IN A RUN
C
C LAST UPDATE:
C-----------------------------------------------------------------
      SUBROUTINE SETUP(FLAG)
C
      LOGICAL   FLAGS,FLAG
      INTEGER*4 ITEM(4),ANSWER,TITLE(5),JTITLE(20),KTITLE(4,4)
      DIMENSION IPDMY(40)
C
      COMMON   /BLOCKE/ IDATE1(4),IDATE2(4),INAME(6),MODULE,ICLASS
      COMMON   /BLOCKF/ FLAGS(7)
      COMMON   /BLOCKG/ DELTA(40),RMIN(40),RMAX(40)
      COMMON   /BLOCKH/ JYEARS,IYEARS(9),IPDAYS(9),IWDAYS(9),IBUDGT(9)
      COMMON   /BLOCKJ/ J1(1, 50),J2( 50),J3( 50),JWORDS,JLENTH,JFREE
      COMMON   /BLOCKK/ K1(1,200),K2(200),K3(200),KWORDS,KLENTH,KFREE
      COMMON   /BLOCKL/ L1(1, 70),L2( 70),L3( 70),LWORDS,LLENTH,LFREE
      COMMON   /BLOCKM/ M1(4,200),M2(200),M3(200),MWORDS,MLENTH,MFREE
      COMMON   /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT( 50),LKOUNT( 70)
C
      DATA     IPDMY/17*1,0,0,3*1,18*0/
C
      DATA      IIZERO   /    2H00  /
      DATA      IDONE    /   4HDONE/
      DATA      IALL     /   4HALL /
      DATA      IYES     /   4HYES /
```

```
      DATA     KTITLE  /'  SH','ORTF','ALL/','BUY ',
     *                 '    ','MIS.',' DEG','.   ',
     *                 '  PI','PELI','ME F','ILL ',
     *                 '    ','READ','INES','S   '/
      DATA     JTITLE  /' OVE','RULE','N NO','DEL ',
     *                 '  SH','ORTF','ALL/','BUY ',
     *                 '    ',' MOD','ULE ','    ',
     *                 '    ','    ','    ','    ',
     *                 '    ','    ','    ','    '/
C-----------------------------------------------------------------------
C     READ DATES, SUBMITTER, MODULE, AND CLASSIFICATION.  PRINT HEADER.
C-----------------------------------------------------------------------
      READ (10)IDATE1
      WRITE(06,88771)IDATE1
88771 FORMAT(1X,4A4)
      READ (05,700)DUMMY
      READ (05,700)INAME
      READ (05,700)IDATE2
      READ (05,700)DUMMY
      READ (05,701)MODULE
      READ (05,701)ICLASS
      K     =5
      DO 1 I=1,4
           JTITLE(K)=KTITLE(I,MODULE)
           K     =K + 1
    1      CONTINUE
      K     =13
      DO 2 I=1,4
           JTITLE(K)=IDATE2(I)
           K     =K + 1
    2      CONTINUE
      K     =17
      DO 3 I=1,4
           JTITLE(K)=INAME(I)
           K     =K + 1
    3      CONTINUE
      IF(FLAG)CALL HEDDA(06,1,80,JTITLE)
C-----------------------------------------------------------------------
C     INITIALIZE AND PRINT MD AND MDS DICTIONARIES
C-----------------------------------------------------------------------
      LWORDS= 1
      LLENTH= 70
      MWORDS= 4
      MLENTH=200
      CALL STORTV(L1,L2,L3,LWORDS,LLENTH,LFREE)
      CALL STORTV(M1,M2,M3,MWORDS,MLENTH,MFREE)
      LCOUNT=0
      MCOUNT=0
   10 READ (10)ITEM
      WRITE(06,88771)ITEM
      IF(ITEM(1) .EQ. IDONE)GO TO 14
      CALL ISTORE($510,ITEM,M1,M2,M3,MWORDS,MLENTH,MFREE)
      MCOUNT=MCOUNT + 1
      CALL IFETCH($10 ,ITEM,M1,M2,M3,MWORDS,MLENTH,MDSLOC)
      DECODE(ITEM,712)MD
      CALL IFETCH($12 ,MD  ,L1,L2,L3,LWORDS,LLENTH,INDEX)
      GO TO 13
   12 CALL ISTORE($511,MD  ,L1,L2,L3,LWORDS,LLENTH,LFREE)
      LCOUNT=LCOUNT + 1
      CALL IFETCH($10 ,MD  ,L1,L2,L3,LWORDS,LLENTH,INDEX)
   13 LKOUNT(INDEX)=LKOUNT(INDEX) + 1
      MDXREF(INDEX,LKOUNT(INDEX))=MDSLOC
```

```
      GO TO 10
   14 IF(.NOT. FLAG)GO TO 16
      CALL PAGE(06)
      WRITE(06,810)
      DO 15 I=1,LCOUNT
            N     =LKOUNT(I)
            WRITE(06,811)I,(L1(J,I),J=1,LWORDS),
     *                     ((M1(J,MDXREF(I,K)),J=1,2),K=1,N)
   15       CONTINUE
C-----------------------------------------------------------------
C     INITIALIZE AND PRINT FSG AND FSC DICTIONARIES
C-----------------------------------------------------------------
   16 JWORDS=  1
      JLENTH= 50
      KWORDS=  1
      KLENTH=200
      CALL STORTV(J1,J2,J3,JWORDS,JLENTH,JFREE)
      CALL STORTV(K1,K2,K3,KWORDS,KLENTH,KFREE)
      JCOUNT=0
      KCOUNT=0
   20 READ (08,704,END=24)ITEM
      DECODE(ITEM,720)ICHAR
      IF(ICHAR .EQ. IIZERO)GO TO 20
      CALL ISTORE($520,ITEM,K1,K2,K3,KWORDS,KLENTH,KFREE)
      KCOUNT=KCOUNT + 1
      CALL IFETCH($20 ,ITEM,K1,K2,K3,KWORDS,KLENTH,IFSLOC)
      DECODE(ITEM,721)IFSG
      CALL IFETCH($22 ,IFSG,J1,J2,J3,JWORDS,JLENTH,INDEX)
      GO TO 23
   22 CALL ISTORE($521,IFSG,J1,J2,J3,JWORDS,JLENTH,JFREE)
      JCOUNT=JCOUNT + 1
      CALL IFETCH($20 ,IFSG,J1,J2,J3,JWORDS,JLENTH,INDEX)
   23 JKOUNT(INDEX)=JKOUNT(INDEX) + 1
      IFXREF(INDEX,JKOUNT(INDEX))=IFSLOC
      GO TO 20
   24 CONTINUE
CCC24 CLOSE(08)
      IF(.NOT. FLAG)GO TO 26
      CALL PAGE(06)
      WRITE(06,820)
      DO 25 I=1,JCOUNT
            N     =JKOUNT(I)
            WRITE(06,821)I,(J1(J,I),J=1,JWORDS),
     *                     ((K1(J,IFXREF(I,K)),J=1,1),K=1,N)
   25       CONTINUE
C-----------------------------------------------------------------
C     READ AND PRINT SENSITIVITY ANALYSIS PARAMETERS
C-----------------------------------------------------------------
   26 IF(FLAG)CALL PAGE(06)
      READ (05,700)DUMMY
      WRITE(06,880)
      DO 30 I=1,40
            READ (05,780)TITLE,DELTA(I),RMIN(I),RMAX(I)
            IF(IPDMY(I).EQ.1)WRITE(06,881)TITLE,DELTA(I),RMIN(I),RMAX(I)
            IF(RMIN(I) .LT. 0.000001)RMIN(I)=1.0E-30
            IF(RMAX(I) .LT. 0.000001)RMAX(I)=1.0E+30
   30       CONTINUE
C-----------------------------------------------------------------
C     READ AND PRINT USER OPTIONAL REPORT SELECTION FOR THIS RUN.
C-----------------------------------------------------------------
```

```
      WRITE(06,882)
      READ (05,700)DUMMY
      DO 35 I=1,7
            FLAGS(I)=.FALSE.
            READ (05,701)TITLE,ANSWER
            WRITE(06,883)TITLE,ANSWER
            IF(ANSWER .EQ. IYES)FLAGS(I)=.TRUE.
   35       CONTINUE
C-----------------------------------------------------------------------
C     READ USER SCENARIO DECISIONS FOR THIS RUN
C-----------------------------------------------------------------------
      READ (05,700)DUMMY
      JYEARS=0
   40 READ (05,702)IYEAR,I,J,K
      IF(IYEAR .EQ. IDONE)GO TO 51
      JYEARS=JYEARS + 1
      DECODE(IYEAR,703)JYEAR
      IYEARS(JYEARS)=JYEAR
      IPDAYS(JYEARS)=I
      IWDAYS(JYEARS)=J
      IBUDGT(JYEARS)=K
      GO TO 40
C-----------------------------------------------------------------------
C     READ AND PRINT USER MDS SELECTION FOR THIS RUN
C-----------------------------------------------------------------------
   51 IF(FLAG)CALL PAGE(06)
      READ (05,700)DUMMY
      NUMMDS=0
      WRITE(06,850)
   50 READ (05,710,END=60)ITEM
      IF(ITEM(1) .EQ. IALL )GO TO 58
      IF(ITEM(1) .EQ. IDONE)GO TO 60
      CALL IFETCH($56 ,ITEM,M1,M2,M3,MWORDS,MLENTH,INDEX)
      NUMMDS=NUMMDS + 1
      WRITE(06,851)NUMMDS,ITEM
      LSTMDS(NUMMDS)=INDEX
      GO TO 50
   56 CALL IFETCH($550,ITEM,L1,L2,L3,LWORDS,LLENTH,INDEX)
      N     =LKOUNT(INDEX)
      DO 57 I=1,N
            NUMMDS=NUMMDS + 1
            WRITE(06,851)NUMMDS,(M1(J,MDXREF(INDEX,I)),J=1,MWORDS)
            LSTMDS(NUMMDS)=MDXREF(INDEX,I)
   57       CONTINUE
      GO TO 50
   58 DO 59 I=1,MCOUNT
            LSTMDS(I)=I
   59       CONTINUE
      NUMMDS=MCOUNT
      WRITE(06,852)NUMMDS
      GO TO 50
C-----------------------------------------------------------------------
C     READ AND PRINT USER FSC SELECTION FOR THIS RUN
C-----------------------------------------------------------------------
   60 IF(FLAG)CALL PAGE(06)
      READ (05,700)DUMMY
      NUMFSC=0
      WRITE(06,860)
   65 READ (05,710,END=70)ITEM
      IF(ITEM(1) .EQ. IALL )GO TO 68
      IF(ITEM(1) .EQ. IDONE)GO TO 70
      CALL IFETCH($66 ,ITEM,K1,K2,K3,KWORDS,KLENTH,INDEX)
```

```
      NUMFSC=NUMFSC + 1
      WRITE(06,851)NUMFSC,ITEM
      LSTFSC(NUMFSC)=INDEX
      GO TO 65
   66 CALL IFETCH($560,ITEM,J1,J2,J3,JWORDS,JLENTH,INDEX)
      N     =JKOUNT(INDEX)
      DO 67 I=1,N
            NUMFSC=NUMFSC + 1
            WRITE(06,851)NUMFSC,(K1(J,IFXREF(INDEX,I)),J=1,KWORDS)
            LSTFSC(NUMFSC)=IFXREF(INDEX,I)
   67       CONTINUE
      GO TO 65
   68 DO 69 I=1,KCOUNT
            LSTFSC(I)=I
   69       CONTINUE
      NUMFSC=KCOUNT
      WRITE(06,852)NUMFSC
      GO TO 65
C-----------------------------------------------------------------
C     READ AND PRINT USER ALC SELECTION FOR THIS RUN.
C-----------------------------------------------------------------
   70 NUMALC=0
      READ (05,700)DUMMY
   71 READ (05,710,END=90)IALC
      IF(IALC .EQ. IALL )GO TO 71
      IF(IALC .EQ. IDONE)GO TO 90
      NUMALC=NUMALC + 1
      IF(NUMALC .GT. 1)GO TO 72
      IF(FLAG)CALL PAGE(06)
      WRITE(06,870)
   72 WRITE(06,851)NUMALC,IALC
      LSTALC(NUMALC)=IALC
      GO TO 71
   90 RETURN
C-----------------------------------------------------------------
C     ERROR CONDITIONS
C-----------------------------------------------------------------
  510 WRITE(06,910)ITEM
      GO TO 10
  511 WRITE(06,911)ITEM
      GO TO 10
  520 WRITE(06,920)ITEM
      GO TO 20
  521 WRITE(06,921)ITEM
      GO TO 20
  550 WRITE(06,950)ITEM
      GO TO 50
  560 WRITE(06,960)ITEM
      GO TO 65
C-----------------------------------------------------------------
C     INPUT FORMATS
C-----------------------------------------------------------------
  700 FORMAT(1X,6A4)
  701 FORMAT(1X,I4)
  702 FORMAT(1X,A4,2(I4,3X),I7)
  703 FORMAT(I4)
  704 FORMAT(3A4,A3)
  710 FORMAT(1X,3A4,A3)
  712 FORMAT(2X,A4)
  720 FORMAT(2X,A2)
  721 FORMAT(A2)
```

```
 780 FORMAT(1X,5A4,1X,F9.2,2(1X,F5.1))
 781 FORMAT(1X,5A4,7X,A3)
C-----------------------------------------------------------------
C     OUTPUT FORMATS
C-----------------------------------------------------------------
 810 FORMAT('0MDS TO MD CROSS REFERENCE TABLE:',//)
 811 FORMAT(I4,1X,A4,15(1X,A4,A3),/,9X,15(1X,A4,A3))
 820 FORMAT('0FSC TO FSG CROSS REFERENCE TABLE:',//)
 821 FORMAT(I4,1X,A4,20(1X,A4))
 850 FORMAT('0THESE MDS WILL BE USED IN THIS RUN OF THE MODEL:',//)
 851 FORMAT(I4,1X,3A4,A3)
 852 FORMAT('0ALL ',I3,' WILL BE USED.')
 860 FORMAT('0THESE FSC WILL BE USED IN THIS RUN OF THE MODEL:',//)
 870 FORMAT('0THESE ALC WILL BE USED IN THIS RUN OF THE MODEL:',//)
 880 FORMAT('0DATA CONTROL SECTION:',/,
    *       ' --------------------- ',//,
    *       ' ITEM LEVEL PARAMETER    FACTOR  MIN  MAX',/,
    *       ' --------------------    ------ ---- ----')
 881 FORMAT(1X,5A4,1X,F9.2,2(1X,F5.1))
 882 FORMAT('0OPTIONAL REPORTS REQUESTED:',/,
    *       ' --------------------------- ')
 883 FORMAT(1X,5A4,7X,A3)
C-----------------------------------------------------------------
C     ERROR FORMATS
C-----------------------------------------------------------------
 910 FORMAT(' CANNOT STORE ',3A4,A3,' IN MDS DICTIONARY')
 911 FORMAT(' CANNOT STORE ',3A4,A3,' IN MD  DICTIONARY')
 920 FORMAT(' CANNOT STORE ',3A4,A3,' IN FSC DICTIONARY')
 921 FORMAT(' CANNOT STORE ',3A4,A3,' IN FSG DICTIONARY')
 950 FORMAT(' CANNOT FIND  ',3A4,A3,' IN MD  OR MDS DICTIONARY')
 960 FORMAT(' CANNOT FIND  ',3A4,A3,' IN FSG OR FSC DICTIONARY')
     END
C     'INPUT '  READS OVERVIEW DATA BASE
C
C-----------------------------------------------------------------
C FUNCTION:             THIS SUBROUTINE READS THE OVERVIEW DATA
C                       BASED AND SELECTS RECORDS BASE ON USER
C                       SELECTION CRITERIA FOR OUTPUT TO A TEMPORARY
C                       WORKING FILE.
C
C REQUIRED SUBROUTINES: RANGE, OVREAD, IFETCH, REPT15
C
C LAST UPDATE:
C-----------------------------------------------------------------
      SUBROUTINE INPUT(N)
C
      LOGICAL   FLAG11,FLAG12,FLAG13,FLAG14,FLAG15,FLAG16,FLAG17
      LOGICAL   REJECT,FLAG,IOFLAG,FLAG1
      INTEGER*4 LIST(232),ARRAY(14),ITEMP(200)
      INTEGER*4 MATCH(4)
C
      COMMON  /BLOCKC/ MSN(4),COST,IALT,IPLT,IOST,DP,BP,BCP,DCP,OMBCP,
     *                 OMDCP,FR,URCOST,IBRT,IDRT,IIL,IILS,IILU,IILO,
     *                 NEWVAR(10),IQPA(200)
      COMMON  /BLOCKF/ FLAG11,FLAG12,FLAG13,FLAG14,FLAG15,FLAG16,FLAG17
      COMMON  /BLOCKG/ DELTA(40),RMIN(40),RMAX(40)
      COMMON  /BLOCKK/ K1(1,200),K2(200),K3(200),KWORDS,KLENTH,KFREE
      COMMON  /BLOCKM/ M1(4,200),M2(200),M3(200),MWORDS,MLENTH,MFREE
      COMMON  /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                 IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                 NUMMDS,NUMFSC,NUMALC,JKOUNT( 50),LKOUNT( 70)
```

```
      COMMON   /BLOCKW/ FILL1(63),SRVPCE,SRVWAR,UNSPCE,UNSWAR,IDYS,JDYS
      COMMON   /BLOCKZ/ IORDER(17),AMORDR(4,17),IASSET(15),ASSETS(4,15)
C
      EQUIVALENCE (LIST(1),MSN)
C
      DATA       IBLANK  /    4H     /
      DATA       IALL    /    4HALL  /
      DATA       FLAG1   /   .FALSE./
      DATA       IOFLAG  /   .FALSE./
      DATA       IDONE   /    4HDONE/
C
      WRITE(06,800)
C-----------------------------------------------------------------
C     SET COUNTERS
C-----------------------------------------------------------------
      J     =0
      K     =0
      KK    =0
      L     =0
      LL    =0
      M     =0
      MM    =0
      N     =0
      NN    =0
      NWORDS=NUMWDS + 32
      SRVPCE=0.0
      SRVWAR=0.0
      UNSPCE=0.0
      UNSWAR=0.0
      SPCTP =DELTA(12)
      SPCTW =DELTA(13)
      UPCTP =DELTA(14)
      UPCTW =DELTA(15)
      ORDPCT=DELTA(16)
      LEVEL =INT(DELTA(17))
      MNTHDP=INT(DELTA(18))
      MAX   =INT(DELTA(19))
      AYPCT =DELTA(28)
      BYPCT =DELTA(29)
      EYPCT =DELTA(30)
      READ (05,701)DUMMY
      READ (05,701)IFILE
      IF(IFILE .EQ. IALL)IOFLAG=.TRUE.
      IF(IFILE .EQ. IALL)READ (05,701)DUMMY
      IF(MAX .EQ. 0)MAX   =100000
   10 CALL OVREAD(IALC,MSN,ICOST,IALT,IFLT,IOST,IDEMND,
     *           IDP,IDRT,IDRT,IDCP,IDCP,IECODE,IURC,IORDER,
     *           IASSET,NEWWAR,ITEMP,FLAG)
      IF(FLAG)GO TO 90
      IF(M .EQ. MAX)GO TO 90
      M     =M + 1
      REJECT=.FALSE.
C-----------------------------------------------------------------
C      CHECK DEMAND RATE FOR MISSING CODE(99999)
C-----------------------------------------------------------------
      IF(IDEMND .EQ. 99999)GO TO 505
C-----------------------------------------------------------------
C     CHECK DEMAND RATE FOR ZERO.
C-----------------------------------------------------------------
   11 IF(IDEMND .EQ.     0)GO TO 506
C-----------------------------------------------------------------
C     CHECK ESSENTIALITY LEVEL
C-----------------------------------------------------------------
```

```
   12 IF(IECODE .GT. LEVEL)GO TO 510
C---------------------------------------------------------------
C     CHECK APPLICABILITY TO USER SELECTED FSC LIST
C---------------------------------------------------------------
   15 IF(NUMFSC .EQ. KCOUNT)GO TO 20
      DECODE(MSN(1),710)IFSC
      CALL IFETCH($515,IFSC,K1,K2,K3,KWORDS,KLENTH,INDEX)
      DO 16 I=1,NUMFSC
            IF(INDEX .EQ. LSTFSC(I))GO TO 20
   16       CONTINUE
      GO TO 515
C---------------------------------------------------------------
C     CHECK APPLICABILITY TO USER SELECTED MDS LIST
C---------------------------------------------------------------
   20 ISUM  =0
      DO 24 I=1,NUMMDS
            IQPA(I)=ITEMP(LSTMDS(I))
            ISUM  =ISUM + IQPA(I)
   24       CONTINUE
      IF(ISUM .EQ. 0)GO TO 520
   25 IF(NUMALC .EQ. 0)GO TO 27
      DO 26 I=1,NUMALC
            IF(IALC .EQ. LSTALC(I))GO TO 30
   26       CONTINUE
      GO TO 525
C---------------------------------------------------------------
C     CHECK AGAINST MSN INPUT LIST.
C---------------------------------------------------------------
   27 IF(IOFLAG)GO TO 30
      IF(FLAG1)GO TO 29
   28 READ (05,701)MATCH
      IF(MATCH(1) .EQ. IDONE)GO TO 90
   29 DO 31 I=1,4
            IF(MSN(I) .LT. MATCH(I))GO TO 32
            IF(MSN(I) .GT. MATCH(I))GO TO 33
   31       CONTINUE
      FLAG1 =.FALSE.
      GO TO 30
   32 FLAG1 =.TRUE.
      REJECT=.TRUE.
      MM    =MM + 1
      GO TO 30
   33 MM    =MM + 1
      GO TO 28
   30 IF(REJECT)GO TO 10
      M     =M + 1
C---------------------------------------------------------------
C     CONVERT DATA ELEMENTS.
C---------------------------------------------------------------
C
C           COST & URCOST FACTORS WERE CHANGED FROM 0.01 TO 1.00
C           DCP FACTOR WAS CHANGED FROM 0.01 TO 0.0001.
C                         FOR NAVY MODEL.
C                         ---------------
C---------------------------------------------------------------
      COST  =RANGE((ICOST  * 1.00   * DELTA( 1)),RMIN( 1),RMAX( 1))
      IALT  =RANGE((IALT   * 1.00   * DELTA( 2)),RMIN( 2),RMAX( 2))
      IPLT  =RANGE((IPLT   * 1.00   * DELTA( 3)),RMIN( 3),RMAX( 3))
      IOST  =RANGE((IOST   * 1.00   * DELTA( 4)),RMIN( 4),RMAX( 4))
      FR    =RANGE((IDEMND * 1.E-06 * DELTA( 5)),RMIN( 5),RMAX( 5))
      DP    =RANGE((IDP    * 0.01   * DELTA( 6)),RMIN( 6),RMAX( 6))
      IDRT  =RANGE((IDRT   * 1.00   * DELTA( 7)),RMIN( 7),RMAX( 7))
```

```
      IDRT  =RANGE((IDRT   * 1.00    * DELTA( 8)),RMIN( 8),RMAX( 8))
      BCP   =RANGE((IBCP   * 0.01    * DELTA( 9)),RMIN( 9),RMAX( 9))
      DCP   =RANGE((IDCP   * 0.01    * DELTA(10)),RMIN(10),RMAX(10))
      DCP   =DCP* 0.01
      URCOST=RANGE((IURC   * 1.00    * DELTA(11)),RMIN(11),RMAX(11))
      BP    =1.0 - DP
      OMBCP =1.0 - BCP
      OMDCP =1.0 - DCP
C-----------------------------------------------------------------------
C     INITIALIZE SERVICEABLE AND UNSERVICEABLE ASSETS
C-----------------------------------------------------------------------
      SP    =IASSET(1) + IASSET(2) + IASSET(3)
      UP    =IASSET(4) + IASSET(5) + IASSET(6) + IASSET(7) + IASSET(8)
      SW    =IASSET(14) + IASSET(15)
      UW    =IASSET(11)
      IILSP =INT(SP * SPCTP + .5)
      IILSW =INT(SW * SPCTW + .5)
      IILUP =INT(UP * UPCTP + .5)
      IILUW =INT(UW * UPCTW + .5)
      IILS  =IILSP + IILSW
      IILU  =IILUP + IILUW
      IIL   =IILS + IILU
      SRVPCE=SRVPCE + IILSP * COST
      SRVWAR=SRVWAR + IILSW * COST
      UNSPCE=UNSPCE + IILUP * COST
      UNSWAR=UNSWAR + IILUW * COST
      DO 35 I=1,15
          NUMBER=IASSET(I)
          IF(NUMBER .NE. 0)ASSETS(1,I)=ASSETS(1,I) + 1
          ASSETS(2,I)=ASSETS(2,I) + NUMBER
          ASSETS(3,I)=ASSETS(3,I) + NUMBER * COST
          ASSETS(4,I)=ASSETS(4,I) + NUMBER * URCOST
   35     CONTINUE
C-----------------------------------------------------------------------
C     INITIALIZE ON ORDER ASSETS
C-----------------------------------------------------------------------
      SUM   =0.0
      DO 40 I=1,17
          NUMBER=IORDER(I)
          IF(NUMBER .NE. 0)ONORDR(1,I)=ONORDR(1,I) + 1
          ONORDR(2,I)=ONORDR(2,I) + NUMBER
          ONORDR(3,I)=ONORDR(3,I) + NUMBER * COST
          ONORDR(4,I)=ONORDR(4,I) + NUMBER * URCOST
          SUM   =SUM + NUMBER
   40     CONTINUE
      IILO  =INT(SUM * ORDPCT + .5)
      IIL   =IIL + IILO
C-----------------------------------------------------------------------
C     ADD IN APPROPRIATION YEAR, BUDGET YEAR, EXTENDED YEAR BUYS
C-----------------------------------------------------------------------
      IIL   =IIL + INT(NEWVAR(1) * AYPCT + .5)
      IIL   =IIL + INT(NEWVAR(2) * BYPCT + .5)
      IIL   =IIL + INT(NEWVAR(3) * EYPCT + .5)
      WRITE(01)(LIST(I),I=1,NWORDS)
      IF (FLAG15)CALL REPT15(IECODE)
      GO TO 10
   90 WRITE(06,890)M,LEVEL,J,KK,K,L,LL,MM,NN,N
      RETURN
C-----------------------------------------------------------------------
C     ERROR CONDITIONS
C-----------------------------------------------------------------------
  505 REJECT=.TRUE.
```

```
      WRITE(06,901)MSN,IDEMND
      GO TO 11
  506 KK    =KK + 1
      REJECT=.TRUE.
      GO TO 12
  510 J     =J + 1
      REJECT=.TRUE.
      GO TO 15
  515 K     =K + 1
      REJECT=.TRUE.
      GO TO 20
  520 L     =L + 1
      REJECT=.TRUE.
      GO TO 25
  525 LL    =LL + 1
      REJECT=.TRUE.
      GO TO 27
C-----------------------------------------------------------------------
C     INPUT FORMATS
C-----------------------------------------------------------------------
  701 FORMAT(1X,3A4,A3)
  710 FORMAT(A4)
C-----------------------------------------------------------------------
C     OUTPUT FORMATS
C-----------------------------------------------------------------------
  800 FORMAT('0DATA BASE PROCESSING SECTION:',/,
     *       ' ---------------------------- ',//)
  890 FORMAT('0SUMMARY OF MASTER STOCK NUMBER SELECTION:',/,
     *       ' ---------------------------------------- ',//,
     *        ' TOTAL MSN'S PROCESSED IN DATA BASE            =',I6,/,
     *        ' MSN'S WITH ESSENTIALITY LEVEL > THAN ',I6,3X,'=',I6,/,
     *        ' MSN'S WITH DEMAND RATE OF ZERO                =',I6,/,
     *        ' MSN'S NOT APPLICABLE TO FSC USED IN THIS RUN  =',I6,/,
     *        ' MSN'S NOT APPLICABLE TO MDS USED IN THIS RUN  =',I6,/,
     *        ' MSN'S NOT APPLICABLE TO ALC USED IN THIS RUN  =',I6,/,
     *        ' MSN'S NOT APPLICABLE TO MSN LIST IN THIS RUN  =',I6,/,
     *        ' MSN'S IN MSN LIST BUT NOT IN OVERVIEW DATABASE=',I6,/,
     *        ' TOTAL MSN'S SELECTED FOR THIS RUN             =',I6)
C-----------------------------------------------------------------------
C     ERROR FORMATS
C-----------------------------------------------------------------------
  901 FORMAT(1X,3A4,A3,' REJECTED, DEMAND RATE=',I5)
      END
C      'OVREAD'  READS OVERVIEW DATA BASE
C
C-----------------------------------------------------------------------
C FUNCTION:            THIS SUBROUTINE READS THE OVERVIEW DATA BASE;
C                      IT CAN BE USED BY ANY FORTRAN PROGRAM FOR THIS
C                      PURPOSE.
C                      BECAUSE OF SYSTEM LIMITATIONS,THE OVERVIEW DATA
C                      BASE EXISTS AS A PACKED/CONDENSED BINARY FILE.
C                      OVREAD'S PRIMARY FUNCTION IS TO UNPACK IT FOR
C                      PROCESSING.
C REQUIRED FUNCTIONS:  IPOINT
C
C VARIABLES:           XXXXX
C
C LAST UPDATE:
C
C-----------------------------------------------------------------------
```

```
      SUBROUTINE OVREAD(IALC,MSN,ICOST,IALT,IPLT,IOST,IDEMND,IDP,
     *IBRT,IDRT,IBCP,IDCP,IECODE,IURC,IORDER,IASSET,NEWOUT,IQPA,FLAG)
C
      LOGICAL   FLAG
      INTEGER*4 MSN(4),IORDER(17),IASSET(15),IQPA(200),NEWOUT(10)
C
      DATA      IEND    /    4H9999/
C
      DO 1 I=1,17
            IORDER(I)=0
    1       CONTINUE
      DO 2 I=1,15
            IASSET(I)=0
    2       CONTINUE
      DO 5  I=1,200
            IQPA(I)=0
    5       CONTINUE
      DO 6 I=1,10
           NEWOUT(I)=0
    6      CONTINUE
      IALC  =IPOINT(NEXT)
      IF(IALC .EQ. IEND) GO TO 45
      DO 10 J=1,4
            MSN(J)=IPOINT(NEXT)
   10       CONTINUE
      ICOST =IPOINT(NEXT)
      IALT  =IPOINT(NEXT)
      IPLT  =IPOINT(NEXT)
      IOST  =IPOINT(NEXT)
      IDEMND=IPOINT(NEXT)
      IDP   =IPOINT(NEXT)
      IBRT  =IPOINT(NEXT)
      IDRT  =IPOINT(NEXT)
      IBCP  =IPOINT(NEXT)
      IDCP  =IPOINT(NEXT)
      IECODE=IPOINT(NEXT)
      IURC  =IPOINT(NEXT)
      NPAIRS=IPOINT(NEXT)
      IF(NPAIRS .EQ. 0)GO TO 25
      DO 20 J=1,NPAIRS
            INDEX =IPOINT(NEXT)
            IORDER(INDEX)=IPOINT(NEXT)
   20       CONTINUE
   25 NPAIRS=IPOINT(NEXT)
      IF(NPAIRS .EQ. 0)GO TO 35
      DO 30 J=1,NPAIRS
            INDEX =IPOINT(NEXT)
            IASSET(INDEX)=IPOINT(NEXT)
   30       CONTINUE
   35 DO 36 I=1,10
            NEWOUT(I)=IPOINT(NEXT)
   36       CONTINUE
      NPAIRS=IPOINT(NEXT)
      IF(NPAIRS.EQ.0) GO TO 50
      DO 40  I=1,NPAIRS
             INDEX=IPOINT(NEXT)
             IQPA(INDEX)=IPOINT(NEXT)
   40        CONTINUE
      RETURN
   45 FLAG  =.TRUE.
   50 RETURN
      END
```

```
C      'STORTV'  GENERALIZED STORAGE AND RETRIEVAL ROUTINES
C
C-----------------------------------------------------------------
C FUNCTION:             THE SUBROUTINE 'STORTV' INITIALIZES STORAGE
C                       FOR MDS DICTIONARY.
C
C STATUS:               SUBROUTINE
C
C LANGUAGE:             FORTRAN IV
C
C LAST UPDATE:
C-----------------------------------------------------------------
      SUBROUTINE HEADER(INPUT,OUTPUT,NTIMES)
C
      REAL*8    IMAGE(7,63)
      INTEGER*4 OUTPUT,ICHARS(63),ICARD(80),ITEMP(80),IPOINT(1)
C
      DATA       ICHARS  /1H ,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,
     *                    1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,
     *                    1HL,1HM,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,
     *                    1HW,1HX,1HY,1HZ,1H(,1H),1H*,1H$,1H+,1H-,1H/,
     *                    1H=,1H,,1H.,1H%,1H&,1H",1H>,1H;,1H:,1H',1H<,
     *                    1H_,1H!,1H#,1H ,1H?,1H ,1H ,1H /
      DATA       IMAGE   /
     B 7*7H       ,
     * 7H 00000 ,5*7H0     0,7H 00000 ,
     1 4H   1,4H  11,4*4H   1,5H  111,
     2 6H 22222,7H2     2,7H      2,6H  2222,2H 2,1H2,7H2222222,
     3 6H 33333,7H3     3,6H     3,6H    33,6H     3,7H3     3,6H 33333,
     4 5H    4,5H   44,5H  4 4,5H 4  4,7H4444444,2*5H    4,
     5 7H5555555,2*1H5,6H555555,7H      5,7H5     5,6H 55555,
     6 6H 66666,7H6     6,1H6,6H666666,2*7H6     6,6H 66666,
     7 7H7777777,6H     7,5H    7,4H   7,3H  7,2H 7,1H7,
     8 6H 88888,2*7H8     8,6H 88888,2*7H8     8,6H 88888,
     9 6H 99999,2*7H9     9,7H 999999,7H      9,7H      9,6H 99999,
     A 7H   A   ,7H  A A  ,7H A   A ,7HAAAAAAA,3*7HA     A,
     B 6HBBBBBB,2*7HB     B,6HBBBBBB,2*7HB     B,6HBBBBBB,
     C 6H CCCCC,7HC     C,3*1HC,7HC     C,6H CCCCC,
     D 6HDDDDDD,5*7HD     D,6HDDDDDD,
     E 7HEEEEEEE,2*1HE,5HEEEEE,2*1HE,7HEEEEEEE,
     F 7HFFFFFFF,2*1HF,5HFFFFF,3*1HF,
     G 6H GGGGG,7HG     G,1HG,7HG  GGGG,2*7HG     G,6H GGGGG,
     H 3*7HH     H,7HHHHHHHH,3*7HH     H,
     I 6H IIIII,5*4H   I,6H IIIII,
     J 4*7H      J,2*7HJ     J,6H JJJJJ,
     K 7HK     K,6HK    K,5HK   K,4HKKKK,5HK   K,6HK    K,7HK     K,
     L 6*1HL,7HLLLLLLL,
     M 7HM     M,7HMM   MM,7HM M M M,7HM  M  M,3*7HM     M,
     N 7HN     N,7HNN    N,7HN N   N,7HN  N  N,7HN   N N,7HN    NN,
     N 7HN     N,
     O 7HOOOOOOO,5*7HO     O,7HOOOOOOO,
     P 6HPPPPPP,2*7HP     P,6HPPPPPP,3*1HP,
     Q 6H QQQQQ,3*7HQ     Q,7HQ  QQ Q,7HQ   QQQ,7H QQQQQQ,
     R 6HRRRRRR,2*7HR     R,6HRRRRRR,5HR   R,6HR    R,7HR     R,
     S 6H SSSSS,7HS     S,1HS,6H SSSSS,7H      S,7HS     S,6H SSSSS,
     T 7HTTTTTTT,6*4H   T,
     U 6*7HU     U,6H UUUUU,
     V 4*7HV     V,6H V   V,5H  V V,4H   V,
     W 3*7HW     W,7HW  W  W,7HW W W W,7HWW   WW,7HW     W,
     X 7HX     X,6H X   X,5H  X X,4H   X,5H  X X,6H X   X,7HX     X,
     Y 7HY     Y,6H Y   Y,5H  Y Y,4*4H   Y,
```

```
Z 7HZZZZZZZ,6H    Z,5H    Z,4H   Z,3H  Z,2H Z,7HZZZZZZZ,
( 5H    (,4H   (,3*3H  (,4H   (,5H    (,
) 3H  ),4H   ),3*5H    ),4H   ),3H  ),
* 1H ,4H   *,7H** * **,5H  ***,5H  * *,6H *   *,1H ,
$ 4H   $,6H $$$$$,4H$  $,6H $$$$$,7H   $  $,6H $$$$$,4H   $,
+ 1H ,4H   +,4H   +,7H+++++++,2*4H   +,1H ,
- 3*1H ,6H -----,3*1H ,
/ 7H      /,6H     /,5H    /,4H   /,3H  /,2H /,1H/,
= 2*1H ,6H =====,1H ,6H =====,2*1H ,
, 4*1H ,4H  ,,,4H   ,,3H  ,,
. 5*1H ,2*4H  ..,
% 7H %    %,6H% %%%%,5H %  %,4H   %,6H  %  %,7H %  % %,6H%    %,
& 4H  &&,5H &  &,2*4H  &&,7H &  & &,6H&    &,7H &&&& &,
* 6H "" "",6H  "  ",5H "  ",4*1H ,
* 2H >,3H  >,4H   >,5H    >,4H   >,3H  >,2H >,
* 1H ,2*4H  ..,1H ,2*4H  ,,,3H  ,,
* 1H ,2*4H  ..,1H ,2*4H  ..,1H ,
* 4H  '',4H   ',3H  ',4*1H ,
* 6H     <,5H    <,4H   <,3H  <,4H   <,5H    <,6H     <,
* 6*1H ,7H______,
* 4*4H  !!,1H ,2*4H  ..,
* 1H ,5H  # #,6H #####,5H  # #,6H #####,5H  # #,1H ,
* 1H ,7H       ,7H       ,4*1H ,
* 5H  ???,6H ?   ?,5H ?  ?,2*4H   ?,1H ,4H   .,
* 7*4H    ,
* 5H   '',4H   ',5H    ',4*1H ,
* 6H '' '',5H '  ',6H  '  ',4*1H /
  READ (INPUT,701)ICARD
5 DO 20 J=1,80
        DO 10 K=1,63
              IF(ICARD(J) .EQ. ICHARS(K))GO TO 15
10            CONTINUE
        K     =1
15      ITEMP(J)=K
20      CONTINUE
  ENTRY AGAIN(OUTPUT,NTIMES)
  WRITE(OUTPUT,800)
  DO 30 J=1,NTIMES
        DO 25 K=1,80,16
              L     =K + 15
              WRITE(OUTPUT,801)((IMAGE(I,ITEMP(M)),M=K,L),I=1,7)
25            CONTINUE
30      CONTINUE
  RETURN
  ENTRY HEDDR(OUTPUT,NTIMES,NBR,IPOINT)
  M     =(NBR - 1) / 4 + 1
  K     =0
  DO 32 I=1,M
        DO 31 J=1,4
              K     =K + 1
              ITEMP(K)=ICHARS(1)
              JJ=J
              CALL CONCAT(ITEMP(K),1,IPOINT(I),JJ,1)
31            CONTINUE
32      CONTINUE
  I     =0
  IF(NBR .LT. 17)I     =40 - NBR / 2
  DO 40 J=1,80
        IF(J .LE. I .OR. J .GT. NBR + I)GO TO 35
        ICARD(J)=ITEMP(J)
        GO TO 40
35      ICARD(J)=ICHARS(1)
```

```
 40       CONTINUE
      GO TO 5
  701 FORMAT(80A1)
  800 FORMAT(1H1)
  801 FORMAT(/////,7(3X,16A8,/))
      END
      SUBROUTINE CONCAT(IA,L,IB,J,K)
      DIMENSION IA(L),IB(J),IC(4)
C
      DECODE(IB,801)IC
  801 FORMAT(4A1)
C
      IA(L)=IC(J)
C
      RETURN
      END
C      'PAGE  '  PRINTS NEW HEADER ON ANY OVERVIEW MODEL REPORT
C
C-----------------------------------------------------------------
C FUNCTION:            PRINTS A NEW HEADER PAGE FOR ANY OF THE OVERVIEW
C                      MODEL REPORTS.
C
C STATUS:              SUBROUTINE
C
C LANGUAGE:            FORTRAN IV
C
C LAST UPDATE:
C-----------------------------------------------------------------
      SUBROUTINE PAGE(IUNIT)
C
      INTEGER*4 IPAGE(20),TITLE(7,4),CLASS(6,5)
C
      COMMON   /BLOCKE/ IDATE1(4),IDATE2(4),INAME(6),MODULE,ICLASS
C
      DATA     IPAGE   /      20*0/
      DATA TITLE   /'SHOR','TFAL','L/BU','Y MO','DULE','    ','    ',
     *              'MISS','ION ','DEGR','ADAT','ION ','MODU','LE  ',
     *              'PIPE','LINE',' FIL','L MO','DULE','    ','    ',
     *              'READ','INES','S MO','DULE','    ','    ','    '/
      DATA      CLASS   /'UNCL','ASSI','FIED','    ','    ','    ',
     *                   'FOR ','OFFI','CIAL',' USE',' ONL','Y   ',
     *                   'CLAS','SIFI','ED (','CONF',')   ','    ',
     *                   'CLAS','SIFI','ED (','SECR','ET) ','    ',
     *                   'CLAS','SIFI','ED (','TOP ','SECR','ET) '/
C
      IPAGE(IUNIT)=IPAGE(IUNIT) + 1
      WRITE(IUNIT,801)(TITLE(I,MODULE),I=1,7),IUNIT,IPAGE(IUNIT),
     *               IDATE1,(INAME(I),I=1,6),IDATE2,
     *               (CLASS(I,ICLASS),I=1,6)
      RETURN
  801 FORMAT('1SYNERGY, INC. OVERVIEW MODEL ',7A4,'  REPORT',I3,' PAGE',
     *    I5,/,1X,20A4)
      END
C      'RANGE '  FINDS X SUCH THAT RMIN <= X <= RMAX
C
C-----------------------------------------------------------------
C FUNCTION:            FINDS X SUCH THAT RMIN <= X <= RMAX
C
C STATUS:              FUNCTION
C
C LANGUAGE:            FORTRAN IV
C
```

```
C LAST UPDATE:         28 OCTOBER 1981
C-----------------------------------------------------------------------
      FUNCTION RANGE(X,RMIN,RMAX)
C
      RANGE =X
      IF(X .LT. RMIN)RANGE =RMIN
      IF(X .GT. RMAX)RANGE =RMAX
      IF(RANGE .LT. 0.000001)RANGE =0.0
      RETURN
      END
      FUNCTION IPOINT(IDUMMY)
C
      DIMENSION IDATA(317)
C
      DATA      N      /      317/
C
      N     =N + 1
      IF(N .GT. 317)GO TO 20
   10 IPOINT=IDATA(N)
      RETURN
   20 READ(10)IDATA
      N     =1
      GO TO 10
      END
C      'REPT15  '  OPTIONAL REPORT 15
C
C-----------------------------------------------------------------------
C FUNCTION:             THIS SUBROUTINE ECHOS INPUT DATA
C
C STATUS:               SUBROUTINE
C
C LANGUAGE:             FORTRAN IV
C
C REQUIRED SUBROUTINES:  PAGE
C
C LAST UPDATE:
C-----------------------------------------------------------------------
      SUBROUTINE REPT15(IECODE)
C
      COMMON   /BLOCKC/ MSM(4),COST,IALT,IPLT,IOST,BP,RP,BCP,DCP,OMBCP,
     *                  OMDCP,FR,URCOST,IBRT,IDRT,IIL,IILS,IILU,IILO,
     *                  NEWVAR(10),IQPA(200)
      COMMON   /BLOCKM/ M1(4,200),M2(200),M3(200),MWORDS,MLENTH,MFREE
      COMMON   /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT(50),LKOUNT(70)
C
      DATA       LINES    /          0/
C
      IF(MOD(LINES,50) .NE. 0)GO TO 10
      CALL PAGE(15)
      WRITE(15,810)
   10 DO 20 J=1,NUMMDS
           IF(IQPA(J) .NE. 0)GO TO 30
   20      CONTINUE
   30 WRITE(15,820)MSM,COST,URCOST,IALT,IPLT,IBRT,IDRT,IOST,FR,
     *               BP,BCP,DCP,IECODE,IIL,(M1(I,LSTMDS(J)),I=1,2),
     *               IQPA(J)
      LINES =LINES + 1
      IF(J .EQ. NUMMDS)RETURN
      INDEX =J + 1
```

```
      DO 50 J=INDEX,NUMMDS
            IF(IQPA(J) .EQ. 0)GO TO 50
            IF(MOD(LINES,50) .NE. 0)GO TO 40
            CALL PAGE(15)
            WRITE(15,810)
   40       WRITE(15,830)(M1(I,LSTMDS(J)),I=1,2),IQPA(J)
            LINES =LINES + 1
   50       CONTINUE
      RETURN
  810 FORMAT('0',9X,'MASTER',18X,'UNIT  ADMIN   PROD   BASE  DEPOT',
     * '  ORDER',9X,'   BASE   BASE  DEPOT   ITEM',7X,
     * '   APPLICATIONS',/,
     * 11X,'STOCK',7X,'UNIT     REPAIR   LEAD   LEAD REPAIR REPAIR',
     * ' + SHIP   DEMAND   NRTS  COND.  COND. ESSEN.  STOCK',15('-'),/,
     * 10X,'NUMBER',2(7X,'COST'),5(3X,'TIME'),5X,'RATE   RATE',
     * 2(3X,'PCNT'),3X,'CODE','  LEVEL','  SYSTEM AMOUNT',/,
     * 1X,15('-'),2(' ----------'),5(' ------'),' --------',
     * 5(' ------'),' ------- ------')
  820 FORMAT(1X,3A4,A3,2F11.2,5I7,F9.6,3F7.2,2I7,1X,A4,A3,I7)
  830 FORMAT(118X,A4,A3,I7)
      END
C      'REPT17  '  OPTIONAL REPORT 17
C
C-----------------------------------------------------------------
C
C FUNCTION:            THIS SUBROUTINE PRINTS THE ON-ORDER REPORT
C                      AND THE ON-HAND ASSETS REPORT.
C
C STATUS:              SUBROUTINE
C
C LANGUAGE:            FORTRAN IV
C
C REQUIRED SUBROUTINES: PAGE,WRTROW,UNDER,BLANK,SZERO,TZERO,SUBTTL,TOTAL
C
C LAST UPDATE:
C-----------------------------------------------------------------
C
      SUBROUTINE REPT17
C
      REAL*4    X(4,17),Y(4,15)
C
      COMMON   /BLOCKZ/ IORDER(17),ONORDR(4,17),IASSET(15),ASSETS(4,15)
C
      EQUIVALENCE (ONORDR,X),(ASSETS,Y)
C
      CALL PAGE(17)
      WRITE(17,800)
      WRITE(17,801)
      CALL SZERO
      CALL TZERO
      CALL WRTROW(17,' ON ORDER PR REPORTED      ',27,X(1, 1),4,15,0,28)
      CALL WRTROW(17,' ON ORDER PR FUNDED        ',27,X(1, 2),4,15,0,28)
      CALL WRTROW(17,' ON ORDER CONTRACTOR       ',27,X(1, 3),4,15,0,28)
      CALL WRTROW(17,' ON ORDER PR FUNDED - WRM  ',27,X(1, 4),4,15,0,28)
      CALL WRTROW(17,' ON ORDER CONTRACTOR - WRM ',27,X(1, 5),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL ON ORDER ASSETS     ',27)
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' ISSP SERVICEABLE          ',27,X(1, 6),4,15,0,28)
      CALL WRTROW(17,' ISSP UNSERVICEABLE        ',27,X(1, 7),4,15,0,28)
      CALL WRTROW(17,' ISSP TOC                  ',27,X(1, 8),4,15,0,28)
```

```
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL DUE-IN ASSETS      ',27)
      CALL BLANK (1)
      CALL UNDER ('=')
      CALL TOTAL (17,' TOTAL ON ORDER + DUE-IN  ',27)
      CALL UNDER ('=')
      CALL PAGE(17)
      WRITE(17,802)
      WRITE(17,801)
      CALL TZERO
      CALL SZERO
      CALL WRTROW(17,' SERVICEABLE BASE AND DEPOT',27,Y(1, 1),4,15,0,28)
      CALL WRTROW(17,' SERVICEABLE CONTRACTOR    ',27,Y(1, 2),4,15,0,28)
      CALL WRTROW(17,' SERVICEABLE INTRANSIT     ',27,Y(1, 3),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL SERVICEABLE PEACE  ',27)
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' WRM BASE SERVICEABLE      ',27,Y(1,14),4,15,0,28)
      CALL WRTROW(17,' WRM DEPOT SERVICEABLE     ',27,Y(1,15),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL SERVICEABLE WAR    ',27)
      CALL BLANK (1)
      CALL UNDER ('=')
      CALL TOTAL (17,' TOTAL SERVICEABLE ASSETS ',27)
      CALL UNDER ('=')
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' UNSERVICEABLE BASE        ',27,Y(1, 4),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE DEPOT       ',27,Y(1, 8),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE CNTRCTR SCHD',27,Y(1, 5),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE CNTRCTR UNSC',27,Y(1, 6),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE INTRANSIT   ',27,Y(1, 7),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL UNSERVICEABLE PEACE ',27)
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' WRM DEPOT UNSERVICEABLE   ',27,Y(1,11),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL UNSERVICEABLE WAR  ',27)
      CALL BLANK (1)
      CALL UNDER ('=')
      CALL TOTAL (17,' SERVICEABLE+UNSERVICEABLE ',27)
      CALL UNDER ('=')
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' TECHNICAL ORDER COMPLIANCE',27,Y(1, 9),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE BAILMENT    ',27,Y(1,10),4,15,0,28)
      CALL WRTROW(17,' UNSRV DUE IN FROM OVERHAUL',27,Y(1,12),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE BOTH        ',27,Y(1,13),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL OTHER              ',27)
      CALL BLANK (1)
      CALL UNDER('=')
      CALL TOTAL (17,' TOTAL ASSETS             ',27)
      CALL UNDER ('=')
      RETURN
800   FORMAT('0',//////,1X,'ON-ORDER REPORT',///)
801   FORMAT(27X,'  MASTER ITEMS  NUMBER ITEMS  COST TO REPLACE',
     *         ' COST TO REPAIR',/,
     *      27X,' ------------ ------------- ---------------',
     *         ' --------------',//)
802   FORMAT('0',//////,1X,' ASSET REPORT',///)
       END
```

```
C     'REPT17 '  OPTIONAL REPORT 17
C
C-----------------------------------------------------------------
C
C FUNCTION:           THIS SUBROUTINE PRINTS THE ON-ORDER REPORT
C                     AND THE ON-HAND ASSETS REPORT.
C
C STATUS:             SUBROUTINE
C
C LANGUAGE:           FORTRAN IV
C
C REQUIRED SUBROUTINES: PAGE,WRTROW,UNDER,BLANK,SZERO,TZERO,SUBTTL,TOTAL
C
C LAST UPDATE:
C-----------------------------------------------------------------
C
      SUBROUTINE REPT17
C
      REAL*4    X(4,17),Y(4,15)
C
      COMMON  /BLOCKZ/ IORDER(17),ONORDR(4,17),IASSET(15),ASSETS(4,15)
C
      EQUIVALENCE (ONORDR,X),(ASSETS,Y)
C
      CALL PAGE(17)
      WRITE(17,800)
      WRITE(17,801)
      CALL SZERO
      CALL TZERO
      CALL WRTROW(17,' ON ORDER PR REPORTED      ',27,X(1, 1),4,15,0,28)
      CALL WRTROW(17,' ON ORDER PR FUNDED        ',27,X(1, 2),4,15,0,28)
      CALL WRTROW(17,' ON ORDER CONTRACTOR       ',27,X(1, 3),4,15,0,28)
      CALL WRTROW(17,' ON ORDER PR FUNDED - WRM  ',27,X(1, 4),4,15,0,28)
      CALL WRTROW(17,' ON ORDER CONTRACTOR - WRM ',27,X(1, 5),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL ON ORDER ASSETS     ',27)
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' ISSP SERVICEABLE          ',27,X(1, 6),4,15,0,28)
      CALL WRTROW(17,' ISSP UNSERVICEABLE        ',27,X(1, 7),4,15,0,28)
      CALL WRTROW(17,' ISSP TOC                  ',27,X(1, 8),4,15,0,28)
      CALL WRTROW(17,' RECLAMATION SERVICEABLE   ',27,X(1, 9),4,15,0,28)
      CALL WRTROW(17,' RECLAMATION UNSERVICEABLE ',27,X(1,10),4,15,0,28)
      CALL WRTROW(17,' RECLAMATION TOC           ',27,X(1,11),4,15,0,28)
      CALL WRTROW(17,' TERMINATION SERVICEABLE   ',27,X(1,12),4,15,0,28)
      CALL WRTROW(17,' TERMINATION UNSERVICEABLE ',27,X(1,13),4,15,0,28)
      CALL WRTROW(17,' TERMINATION TOC           ',27,X(1,14),4,15,0,28)
      CALL WRTROW(17,' MAP EXCESS SERVICEABLE    ',27,X(1,15),4,15,0,28)
      CALL WRTROW(17,' MAP EXCESS UNSERVICEABLE  ',27,X(1,16),4,15,0,28)
      CALL WRTROW(17,' MAP EXCESS TOC            ',27,X(1,17),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL DUE-IN ASSETS       ',27)
      CALL BLANK (1)
      CALL UNDER ('=')
      CALL TOTAL (17,' TOTAL ON ORDER + DUE-IN   ',27)
      CALL UNDER ('=')
      CALL PAGE(17)
      WRITE(17,802)
      WRITE(17,801)
```

```
      CALL TZERO
      CALL SZERO
      CALL WRTROW(17,' SERVICEABLE BASE AND DEPOT',27,Y(1, 1),4,15,0,28)
      CALL WRTROW(17,' SERVICEABLE CONTRACTOR    ',27,Y(1, 2),4,15,0,28)
      CALL WRTROW(17,' SERVICEABLE INTRANSIT     ',27,Y(1, 3),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL SERVICEABLE PEACE   ',27)
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' WRM BASE SERVICEABLE      ',27,Y(1,14),4,15,0,28)
      CALL WRTROW(17,' WRM DEPOT SERVICEABLE     ',27,Y(1,15),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL SERVICEABLE WAR     ',27)
      CALL BLANK (1)
      CALL UNDER ('=')
      CALL TOTAL (17,' TOTAL SERVICEABLE ASSETS  ',27)
      CALL UNDER ('=')
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' UNSERVICEABLE BASE        ',27,Y(1, 4),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE DEPOT       ',27,Y(1, 8),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE CNTRCTR SCHD',27,Y(1, 5),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE CNTRCTR UNSC',27,Y(1, 6),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE INTRANSIT   ',27,Y(1, 7),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL UNSERVICEABLE PEACE ',27)
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' WRM DEPOT UNSERVICEABLE   ',27,Y(1,11),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL UNSERVICEABLE WAR   ',27)
      CALL BLANK (1)
      CALL UNDER ('=')
      CALL TOTAL (17,' SERVICEABLE+UNSERVICEABLE ',27)
      CALL UNDER ('=')
      CALL BLANK (1)
      CALL SZERO
      CALL WRTROW(17,' TECHNICAL ORDER COMPLIANCE',27,Y(1, 9),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE BAILMENT    ',27,Y(1,10),4,15,0,28)
      CALL WRTROW(17,' UNSRV DUE IN FROM OVERHAUL',27,Y(1,12),4,15,0,28)
      CALL WRTROW(17,' UNSERVICEABLE DOTM        ',27,Y(1,13),4,15,0,28)
      CALL UNDER ('-')
      CALL SUBTTL(17,' TOTAL OTHER               ',27)
      CALL BLANK (1)
      CALL UNDER('=')
      CALL TOTAL (17,' TOTAL ASSETS              ',27)
      CALL UNDER ('=')
      RETURN
800   FORMAT('0',//////,1X,'ON-ORDER REPORT',///)
801   FORMAT(27X,' MASTER ITEMS  NUMBER ITEMS  COST TO REPLACE',
     *          ' COST TO REPAIR',/,
     *       27X,' ------------  ------------  ---------------',
     *          ' --------------',//)
802   FORMAT('0',//////,1X,' ASSET REPORT',///)
      END
```

```
C      'WRTROW'  INSERTS COMMAS INTO NUMBERS
C      ---------------------------------
C
C-----------------------------------------------------------------------
C FUNCTION:            THIS SUBROUTINE INSERTS COMMAS INTO THE ARRAY
C                      OF NUMBERS PASSED TO IT AND PRINTS THEM OUT
C                      ALONG WITH THE STUB ACCORDING TO THE FIELD,
C                      'WIDTH', AND DECIMAL, 'IDEC', PARAMETERS
C                      SUPPLIED.  IT HAS SEVERAL ENTRY POINTS:
C
C                      UNDER     UNDERLINES WITH CHARACTER 'ICHAR'
C                      BLANK     PRINTS 'N' BLANK LINES
C                      SZERO     ZEROES OUT SUBTOTAL ACCUMULATOR
C                      TZERO     ZEROES OUT TOTAL ACCUMULATOR
C                      SUBTTL    PRINTS OUT SUBTOTAL ACCUMULATOR
C                      TOTAL     PRINTS OUT TOTAL ACCUMULATOR
C
C STATUS:              SUBROUTINE
C
C LANGUAGE:            FORTRAN IV
C
C PRECISION:           SINGLE
C
C REQUIRED SUBROUTINES: NONE
C
C LAST UPDATE:
C
C-----------------------------------------------------------------------
C
      SUBROUTINE WRTROW(IUNIT,STUB,LEN.SAVE,LEN1,IWIDTH,IDEC,ISTART)
C
      DIMENSION SAVE(LEN1),IBUF(132)
      DIMENSION DATA(12),IDATA(12),NUMBER(10),TOTAL1(12),TOTAL2(12)
      CHARACTER STUB*LEN
C
      DATA      IBLANK  /4H       /
      DATA      MINUS   /1H-      /
      DATA      ICOMMA  /1H,      /
      DATA      IPOINT  /1H.      /
      DATA      IASTER  /1H*      /
      DATA      NUMBER  /1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9/
C
      IF(LEN1 .EQ. 0)GO TO 2
      DO  1 I=1,LEN1
            TOTAL1(I)=TOTAL1(I) + SAVE(I)
            TOTAL2(I)=TOTAL2(I) + SAVE(I)
 1          DATA(I)=SAVE(I)
C
 2    DO  3 I=1,132
 3          IBUF(I)=IBLANK
      DECODE(STUB,801)IBUF
      IF(LEN1 .EQ. 0)GO TO 70
C
      L     =LEN1
      IF(IDEC  )5,5,6
 5    DO 53 I=1,L
            IF(DATA(I))51,52,52
 51         IDATA(I)=INT(DATA(I) - .5)
            GO TO 53
 52         IDATA(I)=INT(DATA(I) + .5)
 53         CONTINUE
      GO TO 8
```

```
C
    6  FMULT=FLOAT(10**IDEC)
       DO 7 I=1,LEN1
    7       DATA(I)=DATA(I)*FMULT
       GO TO 5
C
    8  INIT  =ISTART
       DO 60 L=1,LEN1
            KEEP  =IABS(IDATA(L))
            IFIN  =INIT + IWIDTH - 1
            NEXT  =IFIN + 1
            IF(IDEC .EQ. 0)GO TO 10
C
            DO 9 I=1,IDEC
                 J     =MOD(KEEP,10) + 1
                 IBUF(IFIN)=NUMBER(J)
                 KEEP  =KEEP / 10
                 IFIN  =IFIN - 1
                 IF(IFIN .LT. INIT)GO TO 30
    9            CONTINUE
            IBUF(IFIN)=IPOINT
            IFIN  =IFIN - 1
            IF(IFIN .LT. INIT)GO TO 30
C
   10       DO 20 I=1,3
                 J     =MOD(KEEP,10) + 1
                 IBUF(IFIN)=NUMBER(J)
                 KEEP  =KEEP / 10
                 IF(KEEP .EQ. 0)GO TO 50
                 IFIN  =IFIN - 1
                 IF(IFIN .LT. INIT)GO TO 30
   20            CONTINUE
            IBUF(IFIN)=ICOMMA
            IFIN  =IFIN - 1
            IF(IFIN .GE. INIT)GO TO 10
C
   30       IFIN  =INIT + IWIDTH - 1
            DO 40 I=INIT,IFIN
   40            IBUF(I)=IASTER
            GO TO 60
C
   50       IF(DATA(L))55,60,60
   55       IF(IFIN .LE. INIT)GO TO 30
            IBUF(IFIN - 1)=MINUS
C
   60       INIT  =NEXT
   70  IF(INIT .LT. 1 .OR. INIT .GT. 132)INIT=132
       WRITE(IUNIT,801)(IBUF(I),I=1,INIT)
       RETURN
C-----------------------------------------------------------------
C      UNDERLINE THE LAST LINE PRINTED.
C-----------------------------------------------------------------
       ENTRY UNDER (ICHAR)
       DO 71 I=1,132
   71       IBUF(I)=IBLANK
       K     =ISTART
       DO 80 I=1,L
            N     =IWIDTH - 1
            DO 75 J=1,N
                 IBUF(K + 1)=ICHAR
   75            K     =K + 1
            K     =K + 1
   80       CONTINUE
```

```
      GO TO 70
C-----------------------------------------------------------------
C     PRINT 'M' BLANK LINES.
C-----------------------------------------------------------------
      ENTRY BLANK (M)
      DO 85 I=1,M
 85         WRITE(IUNIT,801)IBLANK
      RETURN
C-----------------------------------------------------------------
C     ZERO OUT SUBTOTAL ACCUMULATORS.
C-----------------------------------------------------------------
      ENTRY SZERO
      DO 86 I=1,12
 86         TOTAL1(I)=0.0
      RETURN
C-----------------------------------------------------------------
C     ZERO OUT TOTAL ACCUMULATORS.
C-----------------------------------------------------------------
      ENTRY TZERO
      DO 87 I=1,12
 87         TOTAL2(I)=0.0
      RETURN
C-----------------------------------------------------------------
C     PRINT SUBTOTAL ACCUMULATORS
C-----------------------------------------------------------------
      ENTRY SUBTTL(IUNIT,STUB,LEN)
      DO 88 I=1,12
 88         DATA(I)=TOTAL1(I)
      GO TO 2
C-----------------------------------------------------------------
C     PRINT TOTAL ACCUMULATORS
C-----------------------------------------------------------------
      ENTRY TOTAL (IUNIT,STUB,LEN)
      DO 89 I=1,12
 89         DATA(I)=TOTAL2(I)
      GO TO 2
C-----------------------------------------------------------------
C     OUTPUT FORMAT
C-----------------------------------------------------------------
801   FORMAT(132A1)
      END
C      'FLYHRS'  FLYING HOUR PROGRAM SUBROUTINE
C-----------------------------------------------------------------
C FUNCTION:              THIS SUBROUTINE READS FLYING HOUR PROGRAM,
C                        COMPUTES PEACETIME AND WARTIME FLIGHT HOUR
C                        REQUIREMENT FOR EACH MDS, AND PRINTS FLYING
C                        PROGRAM REPORT.
C
C STATUS:                SUBROUTINE
C
C LANGUAGE:              FORTRAN IV
C
C REQUIRED SUBROUTINES: IFETCH
C
C LAST UPDATE:
C-----------------------------------------------------------------
C
C
```

```
      SUBROUTINE FLYHRS(PRINT,JDAYS,IDAYS)
C
      LOGICAL   PRINT
      INTEGER*4 MDS(4),IPOINT(180),ITEMP(9)
C
      COMMON   /BLOCKA/ IWFHBM(3,36),IPFHBY(200),NUMAC(200)
      COMMON   /BLOCKB/ IYR,JYR,TFH,PFH,IHOURS(36),AD,ABS,ADS,ABI,ADI,
     *                  APRI,BREPRP,BCONBP,BREPRM,BCONBM,DREPRP,DCONDP,
     *                  DREPRM,DCONDM
      COMMON   /BLOCKM/ M1(4,200),M2(200),M3(200),MWORDS,MLENTH,MFREE
      COMMON   /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT(50),LKOUNT(70)
      COMMON   /BLOCKX/ TPARTS(366),TVALUE(366),PHOURS(366),THOURS(366)
C
      DATA       IPOINT  / 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12,13,14,15,
     *                    16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,
     *                    15*31,15*32,30*33,30*34,30*35,30*36/
      DATA       IDONE  /    4HDONE/
C
      IF(IYR .EQ. 1)READ (05,700)DUMMY
      READ (05,701)IYEAR
      LINES =0
      TFH   =0.0
C-----------------------------------------------------------------------
C     READ FLYING HOUR PROGRAM.
C-----------------------------------------------------------------------
   10 READ (05,700)MDS,IPF,NUMBER,X,ITEMP
      IF(MDS(1) .EQ. IDONE)GO TO 60
      CALL IFETCH($10,MDS,M1,M2,M3,MWORDS,MLENTH,INDEX)
      DO 15 II=1,NUMMDS
            I     =LSTMDS(II)
            IF(INDEX .EQ. I)GO TO 20
   15       CONTINUE
      GO TO 10
   20 IPFHBY(INDEX)=IPF
      NUMAC (INDEX)=NUMBER
      TFH   =TFH + IPFHBY(INDEX)
      ACFT  =NUMBER
      Y     =ACFT * X / 100.0
      K     =0
      DO 25 J=1,3
            IFLY=INT(ITEMP(J) * Y + .5)
            DO 24 L=1,5
                  K     =K + 1
                  IWFHBM(INDEX,K)=IFLY
   24             CONTINUE
   25       CONTINUE
      IFLY  =INT(ITEMP(4) * Y + .5)
      DO 26 K=16,30
            IWFHBM(INDEX,K)=IFLY
   26       CONTINUE
      IFLY  =INT(ITEMP(5) * Y + .5)
      IWFHBM(INDEX,31)=IFLY
      IWFHBM(INDEX,32)=IFLY
      IWFHBM(INDEX,33)=INT(ITEMP(6) * Y + .5)
      IWFHBM(INDEX,34)=INT(ITEMP(7) * Y + .5)
      IWFHBM(INDEX,35)=INT(ITEMP(8) * Y + .5)
      IWFHBM(INDEX,36)=INT(ITEMP(9) * Y + .5)
      IF(NUMBER .EQ. 0)GO TO 10
      Y     =FLOAT(IPFHBY(INDEX)) / ACFT
```

```
      IF(MOD(LINES,52) .NE. 0)GO TO 40
      IF(PRINT)CALL PAGE(06)
      IF(PRINT)WRITE(06,801)JYR,(I,I=1,30)
   40 IF(PRINT)WRITE(06,802)(M1(J,INDEX),J=1,2),NUMBER,Y,
     *        IPFHBY(INDEX),X,((IWFHBM(INDEX,J)),J=1,36)
      LINES =LINES + 4
      GO TO 10
   60 TFH   =TFH * JDAYS
      DO 75 I=1,36
            IHOURS(I)=0
            DO 65 K=1,NUMMDS
                 IHOURS(I)=IHOURS(I) + IWFHBM(LSTMDS(K),I)
   65            CONTINUE
   75       CONTINUE
      THOURS(1)=IHOURS(1)
      DO 80 I=2,IDAYS
   80       THOURS(I)=THOURS(I - 1) + IHOURS(IPOINT(I))
      RETURN
  700 FORMAT(1X,3A4,A3,2I6,F6.2,9I3)
  701 FORMAT(1X,I4)
C-----------------------------------------------------------------------
C     OUTPUT FORMATS
C-----------------------------------------------------------------------
  801 FORMAT('0FLYING PROGRAM FOR',I5,':',//,
     *    1X,'              PEACETIME ',42X,'WARTIME FLY HRS/DAY',/,
     *    1X,'             FLY HRS/DAY',T34,99('-'),/,
     *    1X,'             -----------       ',9X,15I6,/,
     *    1X,'               EACH WHOLE',5X,'  EACH',4X,15I6,/,
     *    1X,'MDS      #ACFT  ACFT FLEET',5X,'  ACFT',4X,' 31-45 46-60',
     *                               ' 61-90  -120  -150  -180',/,
     *    1X,'------- ----- ----- -----',5X,' -----',4X,15(' -----'))
  802 FORMAT('0',2A4,I6,F6.2,I6,5X,F6.2,4X,15I6,2(/,42X,15I6))
      END
C      'WAROPT'  WARTIME REQUIREMENT FUNCTION
C
C-----------------------------------------------------------------------
C FUNCTION:             THIS FUNCTION SUBPROGRAM COMPUTES OPTIMUM
C                       WARTIME INVENTORIES.
C
C STATUS:               FUNCTION SUBPROGRAM
C
C LANGUAGE:             FORTRAN IV
C
C LAST UPDATE:
C-----------------------------------------------------------------------
C
      FUNCTION WAROPT(IDAYS,DTOP,MNTHBP)
C
      DIMENSION X(14),IPOINT(365),SHOURS(366)
      LOGICAL   DTOP
C
      COMMON   /BLOCKA/ IWFHBM(3,36),IPFHBY(200),NUMAC(200)
      COMMON   /BLOCKB/ IYR,JYR,TFH,PFH,IHOURS(36),AD,ABS,ADS,ABI,ADI,
     *                  APRI,BREPRP,BCONBP,BREPRM,BCONBM,DREPRP,DCONDP,
     *                  DREPRM,DCONDM
      COMMON   /BLOCKC/ MSN(4),COST,IALT,IPLT,IOST,DP,BP,BCP,DCP,ONBCP,
     *                  ONDCP,FR,URCOST,IBRT,IDRT,IIL,IILS,IILU,IILO,
     *                  NEWVAR(10),IQPA(200)
      COMMON   /BLOCKN/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT(50),LKOUNT(70)
      COMMON   /BLOCKX/ TPARTS(366),TVALUE(366),PHOURS(366),THOURS(366)
      COMMON   /BLOCKY/ DEMAND(366),BPIPE(366),DPIPE(366),BPARTS(366),
                        DPARTS(366),REQMNT(366)
```

```
      *
C
      EQUIVALENCE(X(1),AD)
C
      DATA      IPOINT  / 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12,13,14,15,
     *                    16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,
     *                    15*31,15*32,30*33,30*34,30*35,215*36/
C
      IF(IDAYS .EQ. 0)GO TO 90
      IF(DTOP .AND. (IPLT .LE. MNTHDP))GO TO 90
      DO 20 I=1,36
         IHOURS(I)=0
         DO 10 K=1,NUMMDS
 10         IHOURS(I)=IHOURS(I) + IWFHDM(LSTMDS(K),I) * IQPA(K)
 20      CONTINUE
C
      SHOURS(1)=0.0
      IADD  =IDRT + IOST
C
      OLD   =0.0
      DO 50 I=1,IDAYS
         SHOURS(I + 1)=SHOURS(I) + IHOURS(IPOINT(I))
         AD    =FR * SHOURS(I + 1)
C
         BREPRP=FR * PFH * DP * AMIN0(I,IDRT)
         BCONDP=BCP * BREPRP
         ABS   =BREPRP - BCONDP
C
         DREPRP=FR * PFH * DP * AMIN0(I,IADD)
         DCONDP=DCP * DREPRP
         ADS   =DREPRP - DCONDP
C
         BREPRM=FR * DP * SHOURS(MAX0(0,I - IDRT) + 1)
         BCONDM=BCP * BREPRM
         ABI   =BREPRM - BCONDM
C
         DREPRM=FR * DP * SHOURS(MAX0(0,I - IADD) + 1)
         DCONDM=DCP * DREPRM
         ADI   =DREPRM - DCONDM
C
         APRI  =ABS + ADS + ABI + ADI
         WAROPT=AMAX1(OLD,AD-APRI)
         OLD   =WAROPT
         NPARTS=WAROPT + .5
         PHOURS(I)=PHOURS(I) + SHOURS(I + 1)
         DEMAND(I)=DEMAND(I) + AD
         BPIPE(I) =BPIPE(I)  + ABS
         DPIPE(I) =DPIPE(I)  + ADS
         BPARTS(I)=BPARTS(I) + ABI
         DPARTS(I)=DPARTS(I) + ADI
         REQMNT(I)=REQMNT(I) + WAROPT
         IF(NPARTS .LE. IIL)GO TO 50
         NBUY  =NPARTS - IIL
         TPARTS(I)=TPARTS(I) + NBUY
         TVALUE(I)=TVALUE(I) + NBUY * COST
 50      CONTINUE
      WAROPT=WAROPT + .5
      RETURN
 90   DO 95 I=1,14
         X(I)=0.0
 95      CONTINUE
      WAROPT=0.0
      RETURN
      END
```

```
C        'PESOPT'   PEACETIME REQUIREMENT FUNCTION.
C
C-----------------------------------------------------------------
      FUNCTION PESOPT(IDAYS,DTOP,MNTHDP)
C
      DIMENSION X(14)
C
      LOGICAL   DTOP
C
      COMMON   /BLOCKA/ IMFHBM(3,36),IPFHBY(200),NUMAC(200)
      COMMON   /BLOCKB/ IYR,JYR,TFH,PFH,IHOURS(36),AD,ABS,ADS,ABI,ADI,
     *                  APRI,BREPRP,BCONDP,BREPRM,BCONDM,DREPRP,DCONDP,
     *                  DREPRM,DCONDM
      COMMON   /BLOCKC/ MSN(4),COST,IALT,IPLT,IOST,DP,BP,BCP,DCP,OMBCP,
     *                  OMDCP,FR,URCOST,IBRT,IDRT,IIL,IILS,IILU,IILO,



     *                  OMDCP,FR,URCOST,IBRT,IDRT,IIL,IILS,IILU,IILO,
     *                  NEWVAR(10),IQPA(200)
      COMMON   /BLOCKM/ LSTFSC(200),LSTMDS(200),LSTALC(5),MDXREF(70,20),
     *                  IFXREF(50,20),JCOUNT,KCOUNT,LCOUNT,MCOUNT,
     *                  NUMMDS,NUMFSC,NUMALC,JKOUNT(50),LKOUNT(70)
C
      EQUIVALENCE(X(1),AD)
C
      PFH   =0.0
      DO 10 K=1,NUMMDS
 10        PFH   =PFH + IPFHBY(LSTMDS(K)) * IQPA(K)
      IF(IDAYS .EQ. 0)GO TO 90
      IF(DTOP .AND. (IPLT .LE. MNTHDP))GO TO 90
      DD    =FR * PFH
      AD    =DD * IDAYS
      IADD  =IDRT + IOST
C
      BREPRP=DD * BP * AMIN0(IDAYS,IBRT)
      BCONDP=BCP * BREPRP
      ABS   =BREPRP - BCONDP
C
      DREPRP=DD * DP * AMIN0(IDAYS,IADD)
      DCONDP=DCP * DREPRP
      ADS   =DREPRP - DCONDP
C
      BREPRM=DD * BP * AMAX0(0,IDAYS - IBRT)
      BCONDM=BCP * BREPRM
      ABI   =BREPRM - BCONDM
C
      DREPRM=DD * DP * AMAX0(0,IDAYS - IADD)
      DCONDM=DCP * DREPRM
      ADI   =DREPRM - DCONDM
C
      APRI  =ABS + ADS + ABI + ADI
      PESOPT=AMAX1(0.0,AD-APRI) + .5
      RETURN
 90   DO 95 I=1,14
          X(I)=0.0
 95       CONTINUE
      PESOPT=0.0
      RETURN
      END
```

```
C       'STORTU' INITIALIZES DICTIONARIES.
C
C-----------------------------------------------------------------
C
      SUBROUTINE STORTU(I1,I2,I3,IWORDS,LENGTH,IFREE)
C
      INTEGER*4 I2(LENGTH),I3(LENGTH)
C
      DO 10 I=1,LENGTH
          I2(I) =I + 1
          I3(I) =0
 10       CONTINUE
      I2(LENGTH)=0
      IFREE    =1
      RETURN
      END
C     'ISTORE'  STORES AN ITEM IN TABLE I1
C-----------------------------------------------------------------
      SUBROUTINE ISTORE(*,ITEM,I1,I2,I3,IWORDS,LENGTH,IFREE)
C
      INTEGER*4 ITEM(IWORDS),I1(IWORDS,LENGTH),I2(LENGTH),I3(LENGTH)
      IF(IFREE .EQ. 0)RETURN 1
      DO 15 I=1,IWORDS
 15       I1(I,IFREE)=ITEM(I)
      IHASH    =IABS(MOD(ITEM(1),LENGTH)) + 1
      NEXT     =I2(IFREE)
      I2(IFREE )=I3(IHASH)
      I3(IHASH )=IFREE
      IFREE    =NEXT
      RETURN
      END
C     'IFETCH' FINDS AN ITEM IN TABLE I1 AND PUTS ITS INDEX IN 'INDEX'
C-----------------------------------------------------------------
      SUBROUTINE IFETCH(*,ITEM,I1,I2,I3,IWORDS,LENGTH,INDEX)
C
      INTEGER*4 ITEM(IWORDS),I1(IWORDS,LENGTH),I2(LENGTH),I3(LENGTH)
C
      IHASH    =IABS(MOD(ITEM(1),LENGTH)) + 1
      INDEX    =I3(IHASH)
 20   IF(INDEX .EQ. 0)RETURN 1
      DO 25 I=1,IWORDS
          IF(I1(I,INDEX) .NE. ITEM(I))GO TO 30
 25       CONTINUE
      RETURN
 30   INDEX    =I2(INDEX)
      GO TO 20
      END

end of file - request executed  89 times
```

IV. MUNITIONS MODEL

A. Introduction

This section of the final report summarizes development of a Navy threat-oriented, air-to-air missile (AAM) prototype sustainability model. The munitions capability assessment model was developed according to the following specifications:

> The contractor shall develop a working computer model prototype which relates requirements to current and projected inventories on an individual munition-type basis. The model must be sensitive to changes in key variables such as salvo size, weapon levels, expenditure rates, and shifts in scenarios. In addition, the model must be capable of handling substitution of less preferred munitions for preferred munitions when thay are exhausted.

Synergy developed two types of these munitions models for the Navy. These model types can be broadly defined as an R&D analytical and computer programming effort in order for it to be operational. The applied model focuses on obtaining roughly right answers as quickly as possible. The applied model would utilize whatever standard Navy data were available to determine air-to-air sustainability issued and yield immediate answers. It also includes application of expert judgment. In contrast, the analytical model was an unconstrained research approach to the problem that would obtain these results. It allows sustainability to be analyzed in a much broader context. The model is designed to encourage sensitivity analyses of key variables such as salvo size, weapon loads, and expenditure rates. It allows for substitution of less preferred missiles for preferred missiles when preferred missiles are exhausted.

In this report, three Air-to-Air Missiles (AAMs) are used: the Sparrow, Phoenix, and Sidewinder. The F-14 and F-4 aircraft are also used in this example.

B. Applied Model

1. General Description

The applied model focuses on taking standard Navy data on requirements and inventories to mesh them into a quick turnaround sustainability assessment model. This simplified model matches Navy AAM requirements to RFI inventory in each period of the war.

Two sources of requirements data were analyzed in detail. One source was obtained from the NNOR based on the Defense Guidance Scenario. A problem with these data is that the missile requirements are calculated for the whole war effort and are not time-phased. The essential problem to overcome using these data is developing a methodology which time-phases these requirements. Therefore, an algorithm had to be developed which time-phased the NNOR requirements over the course of the conflict. A second source of data was obtained from a CNA requirements model, NNTOS, which yielded requirements on a weekly basis. This model's output thus required one to match RFI inventory by missile to CNA requirements.

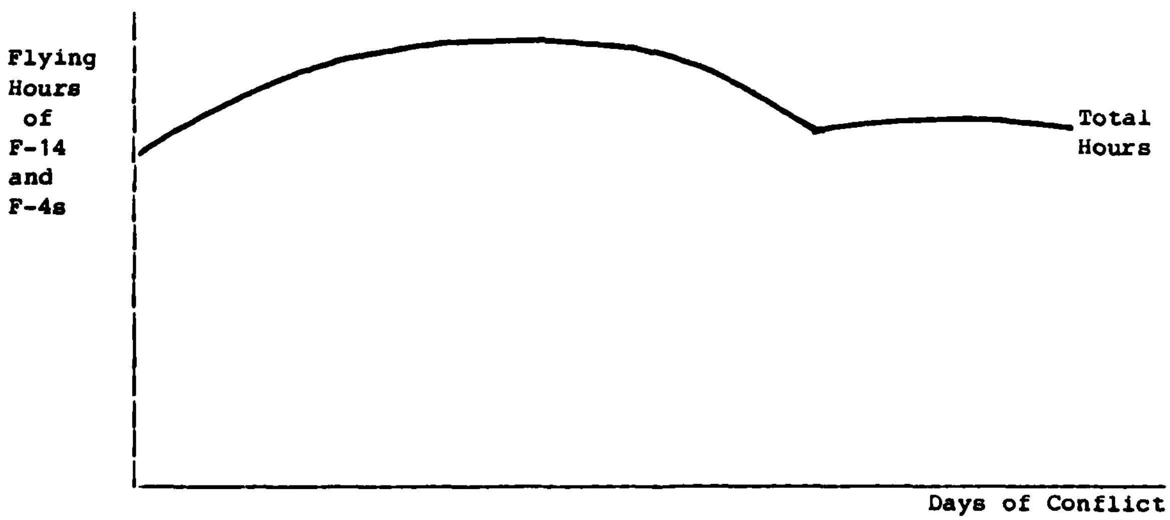
2. Application to DG Scenario

The number of missiles required for the conflict were obtained from the NNOR. Two different confidence levels were examined--the 90 percent confidence level and the 99 percent confidence level. The missiles were assumed to be expended over the course of a war. Two different war lengths were assumed--60 days and 180 days.

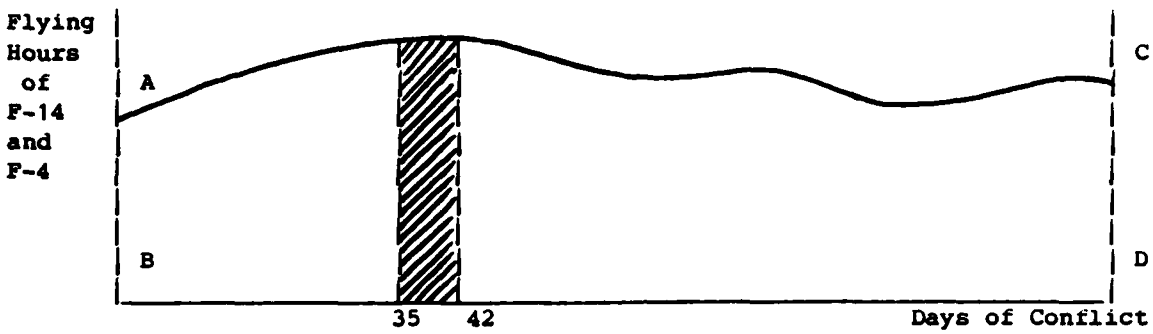
In order to time-phase the missile requirements, it was assumed that missile requirements on a particular week of the war were proportionally related to the amount of F-14 and F-4 combat flying activity. More precisely, it was assumed that the proportion of total missile requirements fired on a particular week were equal to the ratio of combat flying hours scheduled for that week over the total amount of combat flying hours scheduled over the entire course of the war.

To determine the combat flying hour profile required a determination of which carriers were deployed to "hot" theaters. Next, it was necessary to determine the number of F-14 and F-4 aircraft deployed to those carriers in a "hot" theater. This information was obtained from official Navy planning documents and CABAL.

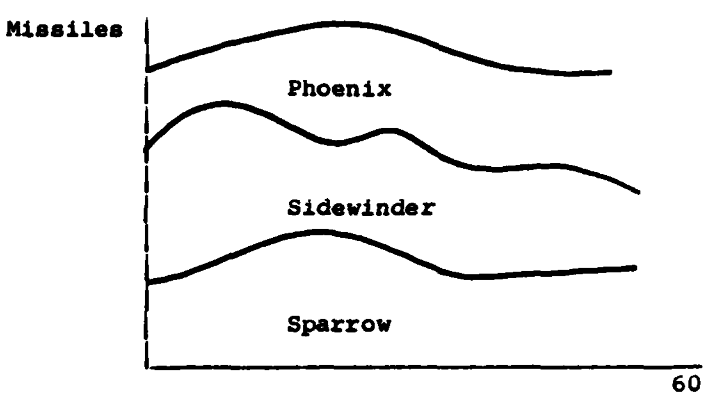
In summary, the carrier deployment schedule indicates the number of carriers that would be engaged on any day of the conflict. The deck-load of each deployed carrier indicates the number of sea-based F-14s and F-4s available for air-to-air combat. The total aircraft available for air-to-air combat also includes shore-based F-14 and F-4 aircraft. The total F-14s and F-4s available were multiplied by the number of flying hours the Navy expected each aircraft type to fly on any particular day of the conflict. The product of this multiplication yielded a flying hour profile over the course of the war. Graphically, the profile could be depicted as:



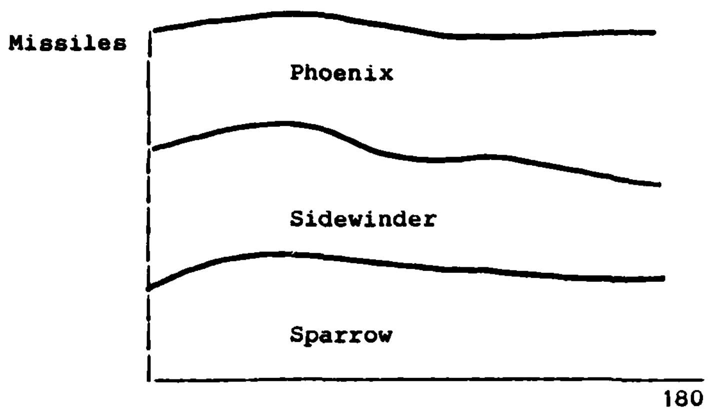
The area under the flying hours curve represented the total possible air-to-air flying hours available during the conflict. For each week of the war, the proportion of total wartime flying hours accounted for during that week were calculated. For days 35 to 42, or week number 6, this would have amounted to dividing the shaded area into the total area under the following curve.



It was then assumed that missile expenditures would occur in direct proportion to the flying hour schedule. Thus, if fifteen percent of the total flying hours occurred in week number 6, then it was assumed that fifteen percent of the total missile requirements would also be fired or consumed in week number 6. This proportionality assumption was applied to all three missile types and allowed for the calculation of the following graphs for both the 60-day and 180-day scenario.



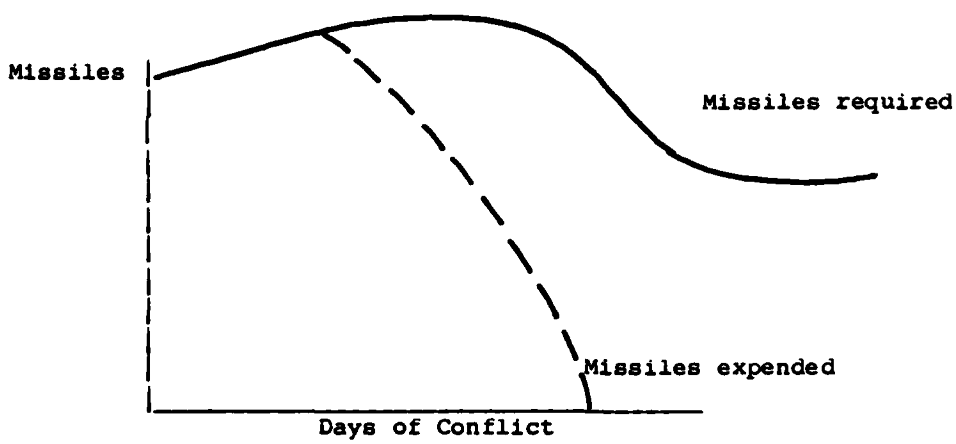
CASE I



CASE II

Once the supplies available at the start of the war and the amount of missiles per week required over the course of the war are estimated, supplies are compared to requirements in each week. At the end of the week, missile expenditures are subtracted from the missile inventory. This calculation determines whether the conflict is sustained for that week for a particular missile type and also enables calculation of missiles ready-for-issue in the next week of the conflict.

For each missile type, the following sustainability display can be constructed:



FY85 missiles ready-for-issue inventories were calculated by subtracting training consumption and the pipeline fill requirements from the sum of the on-hand amount plus those that would be delivered by FY85. Such an analysis was done for an assumed FY85 war.

3. Application to NNTOS Scenario

The same logic was applied to the NNTOS scenario as was to the DG scenario. However, the NNTOS scenario did not require time-phasing logic, as CNA analysts provided their estimates of missile requirements on a weekly basis throughout the conflict. The same sustainability display was developed for this scenario.

C. Analytical Model

This section describes the analytical model which would be used to calculate munitions capability. In includes conceptual framework and a plan for a prototype automated version.

The conceptual framework begins with a number of simplifying assumptions in order to focus on the model's logic.

The simplifying assumptions are:

1. One aircraft type
2. One AAM
3. One theater
4. One target type
5. One carrier
6. No resupply, no procurement, etc.

In effect, this assumes one carrier flying one fighter type armed with one missile type. These simplifying assumptions are made here for explanation purposes. They are not restrictive and the model could be expanded to include _n_ items along any of the above dimensions.

The model can be run or entered from two levels: (1) by directly specifying missile requirements, or (2) by specifying a sortie and/or target profile and generating missile requirements. Level one of the model would be roughly analogous to the applied model presented in Section III below. In this analysis, we concentrate on the second level where missile requirements are generated from sortie and target profiles.

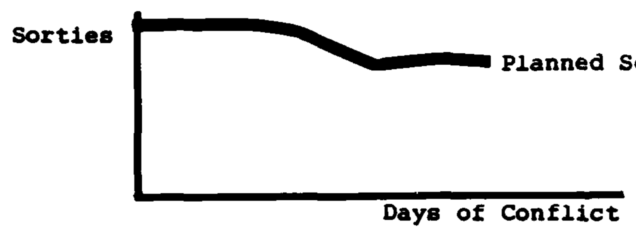
1. Inputted Variables on the Requirements Side

To develop a sustainability model, the specific variables must be inputted. These variables describe the sortie profile, battle parameters, and the relationship between sortie and target profiles. They are exogenous to the model.

The Sortie Profile consists of:

- The number of aircraft at the beginning of the war.
- Either the average sortie rate per aircraft over time or the number of aircraft scheduled to fly missions and the average number of cycles the scheduled aircraft fly.

These variables would be used in generating the following curve (assuming no sortie attrition):



The Battle Parameters are:

- Target intercept rates -- what proportion of the targets will be intercepted.
- Sortie engagement rates -- what proportion of the sorties will be engaged in battle.
- PK rates, salvo size, launch rate, weapon-load, etc. -- variables which determine the performance of the weapon systems.
- Sortie attrition rates, missiles lost due to attrition, exchange rates, etc. -- variables which determine the number of aircraft and missiles which will be lost in an air-to-air war (AAW).
- The target profile -- the distribution of targets over the course of the war.

These battle parameters enable calculation of the number of missiles that will be demanded in order to eliminate all targets or some proportion of them. Alternatively, these battle parameters would allow estimation of the number of targets that would be eliminated given a particular level of missile expenditures.

The Relationship Between Sortie and Target Profiles:

The target and sortie profiles are either implicitly or explicitly linked together. For example, more sorties are expected during thos times the carrier group is under attack. Likewise, increased sortie activity is expected when bomber escort-strike missions are scheduled. In both cases, the sortie schedule would be positively related to the likelihood of increased target presentation.

This estimation process could start with a target profile and not do a sortie profile. For example, the number of missiles required to eliminate a given number of targets (or some proportion of the targets) from the battle parameter variables is determined. The total number of sorties required to achieve our target-kill goals could also be determined. One could even back up further and determine which combinations of aircraft and sortie rates would be necessary to meet the goal of flying the number of sorties scheduled. Obviously, constraints on the sortie rate and aircraft force structure set an upper bound on the sortie profile.

2. Developing Missile Requirements

Sorties flown from carriers are launched in cycles. Aircraft could be seen as flying their sorties on an on-off schedule. They fly a sortie, return to the ship, and, if necessary, fly another sortie. In this case the sortie rate for a particular aircraft could be nothing more than the number of cycles that it is scheduled to fly. For simplification it is assumed that one-half of the aircraft are scheduled for battles in odd cycles and the other half in even cycles.

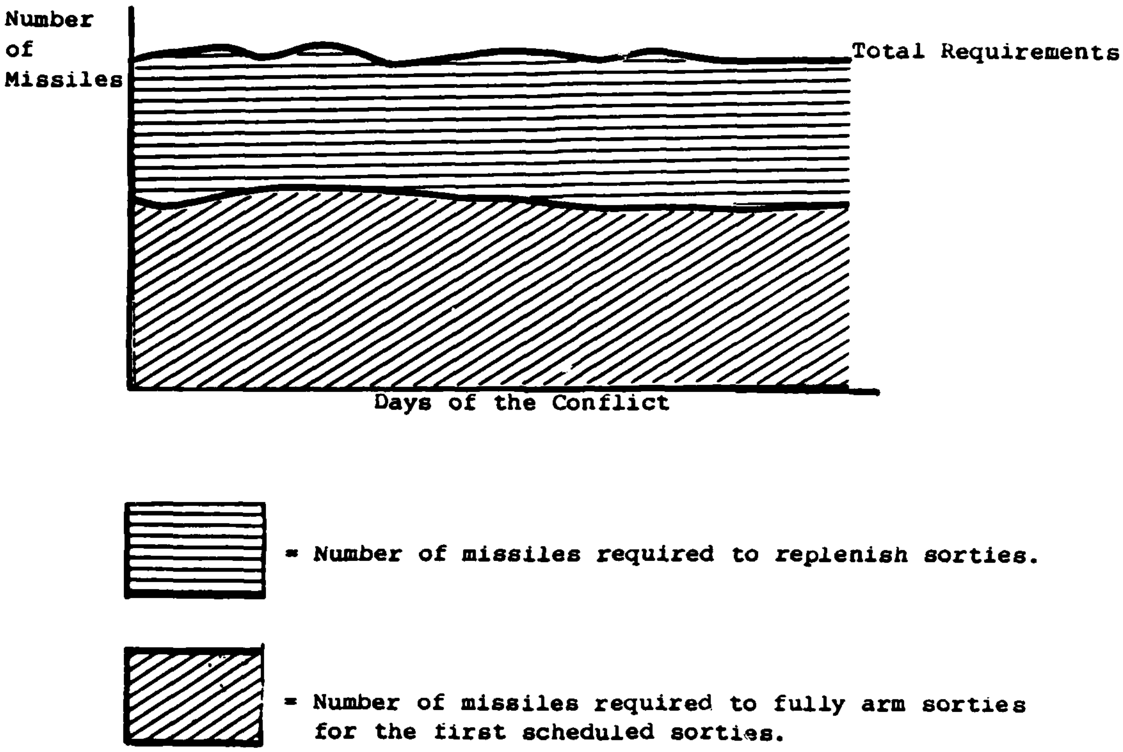
The first task of the day on the carrier is to ready the aircraft scheduled to fly the first cycle. In terms of munitions, this means to arm them with missiles. After the first cycle aircraft depart, the second cycle aircraft are armed. Under the half-odd/half-even simplifying assumption, this means that a component of the missile requirement will be to calculate the number of missiles necessary to arm the scheduled aircraft.

If the carrier only planned to fly two cycles of fighters, this would constitute the missile requirements for that day of the war. All of the sorties scheduled for the day have been armed. However, if more than two cycles have been scheduled, additional missile requirements may be necessary. It is assumed that this is the case in this example.

After the second cycle aircraft depart, the carrier will begin to retrieve the first cycle aircraft. The crew of the carrier will begin immediately to prepare them for departure on the third cycle. To prepare them affects munitions in two ways.

> Aircraft will return to the carrier without a full weapon load, representing missiles expended on their first cycle mission. These "expenditures" must be replenished in order to arm the aircraft for their next cycle sorties.
>
> Aircraft will be attrited. This means that a replacement aircraft, if one is available, must be armed. Initially, we will assume that a replacement aircraft is available. The replacement aircraft, of course, must be armed.

Thus, the missile requirements per day will be made up of two components: those missiles required to arm all aircraft before their first missions of the day and those missiles required to replenish aircraft to fight additional sorties, including arming an aircraft that has replaced an attrited aircraft. Graphically, this could be displayed:



3. Missile Usage

Following the logic of the previous section, missile usage can be divided into two categories: (1) Those expended in earlier (all but the last of the day) sorties and those expended on an aircraft's last sortie of the day. The number of missiles required to be replenished will be equal to the number of missiles expended on earlier sorties. Missiles expended on the last sortie of the day will not be replenished and will not be added to the daily requirements, as adding them to missile requirements would result in double counting. However, they must be accounted for because they must be subtracted from the carrier's inventory.

Missiles will also be classified into two other subcategories:

- those fired at enemy targets;
- those lost and not fired at a target

This includes sortie attrition, missile "pickles," training fires, double-fires (at the same target), etc. This second classification is necessary to compute performance in terms of targets killed.

4. Inputted Variables on the Supply Side

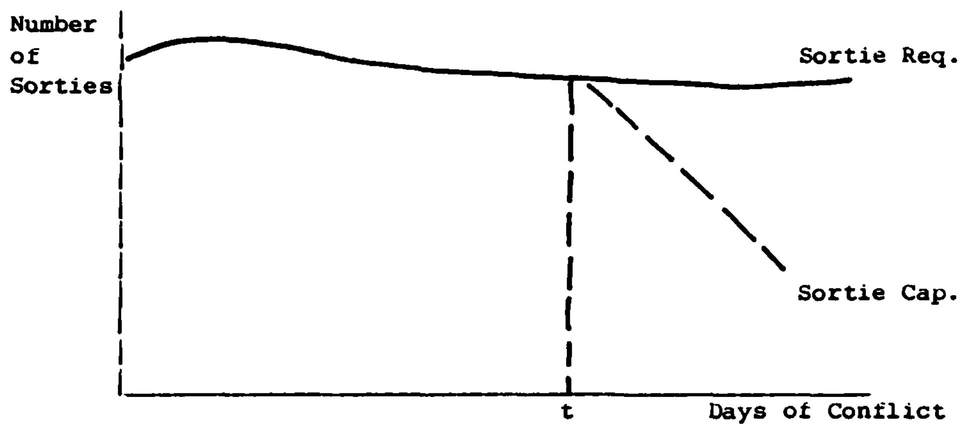
The carrier's initial ready-for-issue (RFI) supplies are inputted into the model. Included in these supplies would be missiles held on adjacent munitions supply ships (AEs). The model does not distinguish between supplies on a carrier or an AE. After each day of the scenario, the number of missiles used is subtracted from the "beginning of the time period RFI." The resultant figure becomes the beginning of the next period's RFI. The effects of resupply are discussed in more detail later in this paper.

5. Sustainability

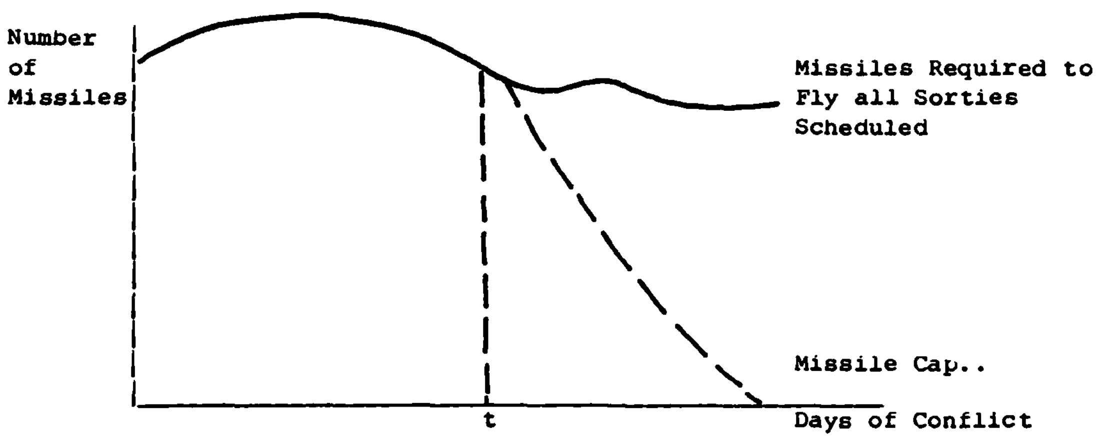
Sustainability analysis can be performed in three areas:

- 1. ability to sustain the sortie profile;
- 2. missile sustainability; and
- 3. ability to eliminate targets.

These displays could look like the following: (Assume sustainability fails on day t.)



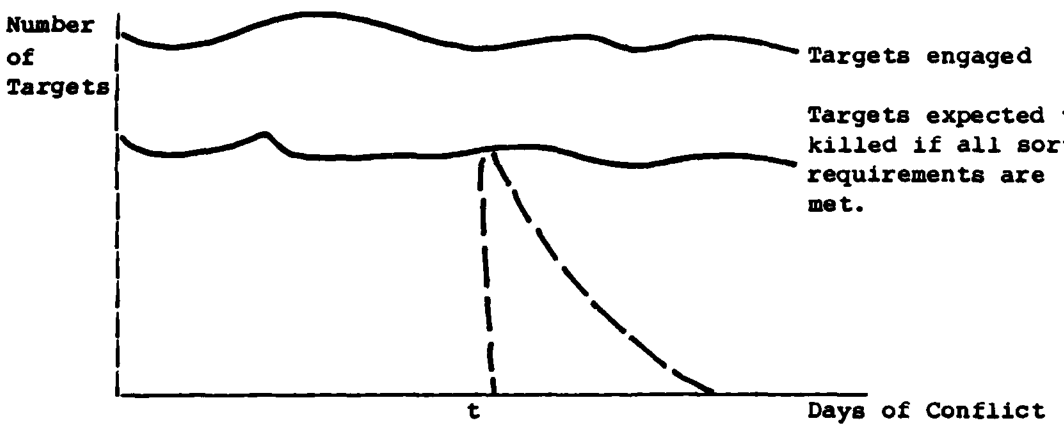
Another way to track sustainability would be in terms of missiles. The total number of missiles required to fly all sorties scneduled could be tracked. This is shown on the following chart. Another way to track missile sustainability is by missile type to generate separate curves or a "stacked" missile sustainability curve.



Finally "sustainability" could be evaluated in terms of the number of targets killed or percent of threat killed. Whether this is called sustainability or performance is relatively unimportant. Because the ultimate goal of the air war is the elimination of threat, the analysis gains significantly if such a tie-in is allowed.

Once battle-field parameters have been entered, the number of missiles fired at enemy targets is known, the expected number of targets that would be that would be eliminated can be calculated.

The following output display could be presented:



At time t, the sortie capability fails to meet the sortie requirements. The immediate effect of this shortfall is a reduction in the target elimination rate.

D. Prototype Automated Model

1. Characteristics

The prototype model focuses on three aircraft, the F-14s, F-4s, and F-18s carrying AAMs. Three AAMs are considered -- Phoenix, Sparrow, and Sidewinder. Carrier deployment and air-to-air combat takes place in three theaters. Each theater is treated as an independent entity. This allows for a wartime scenario which can occur simultaneously or sequentially in any or all theaters. From a technical standpoint, this means that there are three sub-models within the prototype, one for each theater. The underlying analysis for each theater is effectively the same. Worldwide analysis simply means "summing" all theaters.[1]

Resupply to a particular theater can be from intra-theater supplies or from CONUS inventories. The model treats CONUS inventories as those inventories not assigned to a particular fleet. It is assumed that the analyst knows which fleets are assigned to which theaters, and thus can calculate theater-wide inventories.

CONUS supplies are allocated to "hot" theaters first. If hot theater requirements exceed CONUS supplies, then CONUS supplies are allocated to theaters by "fair share" or proportionate logic.

There are two types of threats in the target profile. They are designated as type T_1 and T_2 targets. T_1 targets constitute threats against a battle convoy. T_2 targets constitute threats against friendly bombers. In

---

[1] An expanded model could be developed that allows for a further disaggregation. That is, the model could consider each carrier and land base as a unique entity. This would represent the more detailed level of analysis. The analysts could group these carriers and land bases into a number of ways, each grouping effectively being a theater. In the prototype, we ignore land bases are ignored, only three theater groupings are used.

each case, F-4s, F-14s, and F-18s are required to eliminate the targets or some proportion of the targets. The number of target types could be expanded.

The model allows for weapon load or load out substitution. Each aircraft is inputted with a particular load out. This constitutes a vector of the three missile types. As long as supplies permit planes to be fully loaded out, aircraft are permitted to fly. However, if a full weapon load of optimal mix is not obtainable, a substitute weapon load is permitted as an option of the model.

As in the analytic model, analysis can be done at three levels: sortie sustainability, missile sustainability and target performance.

Finally, the length of the war can be varied.

2. <u>The Current Force Structure Matrix (CFSM)</u>

The essence of the prototype model is keeping track of:

a. Aircraft on each carrier,

b. Munitions available to each carrier, and

c. Munitions available in the U.S. or distant depots. The matrix on the next page illustrates the data required.

Each carrier's inventory of missiles along with its supply ships, would be considered ready-for-issue.[1] Along with the carrier's munitions supply, we would track information on the ship's deck load in terms of the number of F-4s, F-18s, and F-14s it contains and the fleet to which the carrier is assigned.

---

[1] For the prototype, it could simply be assumed that all carriers "look" alike in terms of RFI missiles and deck load. Or alternatively, it could be assumed that all carriers can be grouped into two, three, or four groups. Each carrier within a particular group can be assumed to be like all other carriers in that group.

CURRENT FORCE STRUCTURE MATRIX (CFSM)
FYXX

Status	Missiles			Deck Loads			Fleet Assignment		
Ready for Issue	SP	PH	SI	F-4	F-14	F-18	PAC	LANT	EUR
Carrier #1	SP_1	PH_1	SI_1	0	0	Y	1	0	0
Carrier #2	SP_2	PH_2	SI_2	0	X	0	1	0	0
Carrier #3	-	-	-	Z	0	0	1	0	0
Carrier #4	-	-	-	-	-	-	1	0	0
Carrier #5	-	-	-	-	-	-	0	1	0
Carrier #6	-	-	-	-	-	-	0	1	0
Carrier #7							0	1	0
Carrier #8							0	0	1
Carrier #x	SP_x	PH_x	SI_x				0	0	1
Inventory									
Fleet PAC	SP_p	PH_p	SI_p						
Fleet LANT	SP_l	PH_l	SI_l						
Fleet EUR	SP_e	PH_e	SI_e						
CONUS	SP_c	PH_c	SI_c						

The bottom half of the matrix includes missiles that are not-ready-for-issue. These supplies can be considered part of the pipeline. These supplies include those controlled fleetwide as well as CONUS supplies. CONUS is defined in the prototype as controlling supplies not assigned to a fleet. Aircraft will not be tracked at land bases in the prototype. Conceptually, however, land bases could be considered in the model as carriers.

The CFSM will be tracked on a year-to-year basis. If no war is encountered in a year, the initial matrix will be adjusted to reflect peacetime missile consumption and new physical procurements. Changes in deck loads such as replacement of an aircraft, will be reflected in the relevant year.

Once a war scenario is begun, the matrix will be calculated on a week-by-week basis or whatever time period is chosen. Additional information will be required, the most important of which will be the theater location of a particular carrier. Conceptually, this means that during a war year, the CFSM will add extra columns, each additional column representing a theater.

Like the fleet variable, those carriers in a particular theater are expected to have a value of 1 under the appropriate column. This is shown on the expanded CFSM on the next page. Missile and sortie capabilities for a particular theater are determined by aggregating over all the carriers deployed to that particular theater. It is possible that a carrier is in transition from one theater to another or not engaged in any theater. In such a case, it is denoted that the carrier is not deployed in any theater. This would include carriers drydocked for repair, etc. In the expanded CFSM, a carrier not deployed to any theater would have zero values in all the theater columns. Carrier #7 on the expanded CFSM chart is an example.

EXPANDED CURRENT FORCE STRUCTURE MATRIX (CFSM)
FYXX

Wartime Scenario

Status Ready for Issue	Missiles SP	PH	SI	Deck Loads F-4	F-14	F-18	Fleet Assignment PAC	LANT	EUR	Theater Assignment T1	T2	T3
Carrier #1	SP_1	PH_1	SI_1	0	0	Y	1	0	0	0	0	1
Carrier #2	SP_2	PH_2	SI_2	0	X	0	1	0	0	0	0	1
Carrier #3	-	-	-	Z	0	0	1	0	0	0	1	0
Carrier #4	-	-	-	-	-	-	1	0	0	0	1	0
Carrier #5	-	-	-	-	-	-	0	1	0	0	1	0
Carrier #6	-	-	-	-	-	-	0	1	0	0	1	0
Carrier #7							0	1	0	0	0	0
Carrier #8							0	0	1			
Carrier #x	SP_x	PH_x	SI_x				0	0	1			
Inventory												
Fleet PAC	SP_p	PH_p	SI_p									
Fleet LANT	SP_l	PH_l	SI_l									
Fleet EUR	SP_e	PH_e	SI_e									
CONUS	SP_c	PH_c	SI_c									

As stated earlier, the CFSM during the wartime scenario will change on a week-by-week basis. Initially, on D-day, the matrix will be frozen for the year in which D-day occurs. As the war proceeds, the matrix will change to reflect missiles fired, attrited, etc., and also to reflect changes in carrier deployments.

Additionally, a mathematical algorithm is required to reflect fleetwide and CONUS inventories advancing to the ready-for-issue status. This simply means developing a pipeline equation which lags the transfer of inventory from the fleet depots or the CONUS depot to a particular carrier. The model can accomodate both "hot theater" and "fair share" logic.

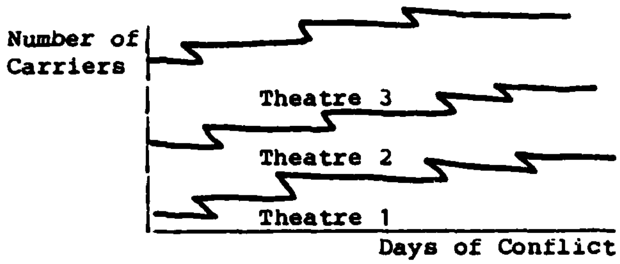
Hot theater means that any carrier or group of carriers involved in combat has first crack at supplies from its fleet or CONUS. Fair-share means that in a case where inventory supplies are insufficient to satisfy every carrier's or fleet's demands, the supplies are proportionally shared among the users in accordance with their requirements.

3. Variables Requiring Inputting

In order for the prototype to have the capability to allow Navy analysts to build their own scenario, the following variables or variable distributions must be inputted for each theater.

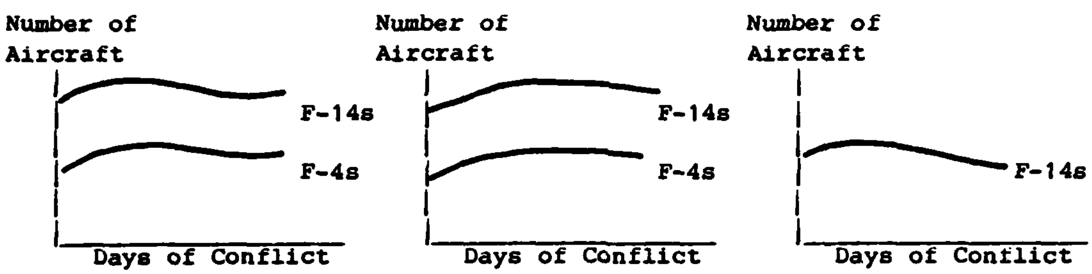
a. Carrier Deployment Schedule

It also assumes that each individual carrier can be tracked to a particular theater on a particular day, unless it is assumed initially that all carriers are alike.



b. Aircraft Deployment

Using the carrier deployment schedule, the aircraft force structure can be determined on a theater basis over the course of the war. These distributions represent the maximum number of aircraft available to each theater. Over the course of the war, it would probably be adjusted downward to reflect attrition.



Theatre 1 Theatre 2 Theatre 3

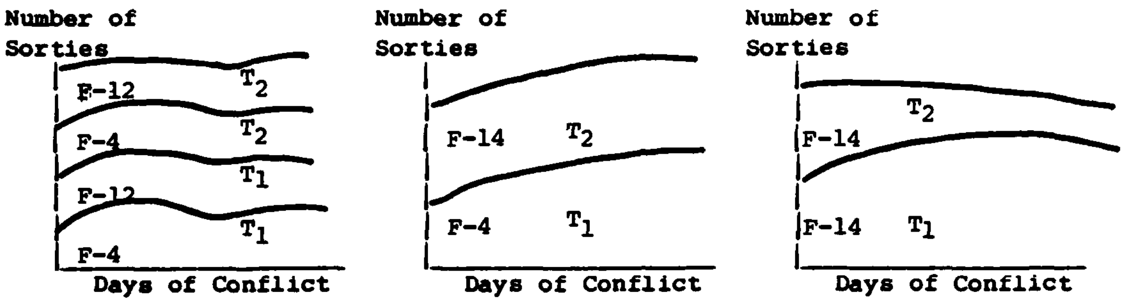
4. <u>Calculating Requirements</u>

Both the sortie-generation approach and the target profile approach can be used to calculate requirements.

a. Sortie-Generator Approach

A sortie profile could be generated by inputting a sortie rate for each theater on each day of the war. The number of aircraft scheduled to fly missions each day and their "cycle" sequence could be translated into the sortie rate.

The type of mission and the number of sorties to be flown could also be specified. That is, a distribution of sorties could be specified to be flown against type 1 targets and type 2 targets. This approach would yield the following distributions:



Theatre 1   Theatre 2   Theatre 3

These distributions could be used to determine how many aircraft would be armed, how many would be required to be replenished, etc. It would involve taking this distribution and reapplying the logic developed in the previsou section.

b. Target-Profile Approach

A second approach would be to input in each theater the target profile expected for that day of the war. Also inputted would be battle parameters such as PKs, intercept rates, engagement rates, exchange ratios, etc. From those parameters, the number of sorties required to eliminate that day's engaged targets (or some specified proportion of those targets) would be inputted. For each theater, the number of sorties required to meet the target kill goals could be generated. A sortie profile generated above the maximum sorties that can be flown implies a force-structure constraint.

In summary, for the target profile approach the number and timing of targets or threats expected to occur are entered for each theater. Given a set of battle parameters, the number of sorties required to achieve the target kill rate can be generated.

5. Calculating Missiles Used

Whether the sortie-generator approach or the target-profile approach is used, the same logic that was developed in the analytical model is contained in prototype in terms of missiles used. In each period, calculations are done for:

a. Missiles fired at targets; and

b. Missiles lost due to attrition of aircraft, ships, duplicate fires, etc.

6. Sustainability Analysis

Each day the number of missiles required to fly the day's sorties is determined. If the number of missiles are available to meet those requirements, the conflict is sustained through that day.

If the missiles are not available, the conflict is not sustained. However, it is possible to build a s·cond level consideration. This may allow for load-out or weapon load substitution. For example, the supply of sidewinders may run out. Aircraft may be allowed to substitute sidewinders with other missile types. Missile substitution would enable the conflict to be sustained for a longer time period.

The same sustainability curves with respect to sorties and missiles developed in Section II can be generated for the prototype. However, they could also be generated for each theater as well as be disaggregated by missile types. Worldwide analysis can be performed by summing over all theaters. Lastly, a detailed target performance profile could be generated for each theater.

Displays for the following sustainability analyses could be generated by the prototype for each theater and, or course, for all theaters summed up:

a. Sorties, including a separate analysis for F-14 sorties, F-14 sorties and F-18 sorties;

b. Missiles, including a separate analysis for Sparrows, Phoenixes, and Sidewinders; and

c. Target kill performance profile, for T_1, the T_2 threat type.

At the end of each time period, after the sustainability analysis and targets killed performance analysis have been conducted, the CFSM is adjusted. The primary adjustment is to reduce all carrier missile loads by the number expended, including those lost due to attrition, etc. In addition, new supplies of missiles from the fleet depot have to be added to the appropriate carriers, and, of course, deducted from the appropriate supply depot. Finally, changes in carrier deployments from one theater to another, or from "transit" to a theater, must be made to the CFSM. After all these adjustments are made, the resultant matrix is the CFSM for the next period of the war.

7. Additional Options in the Prototype

a. Sortie Attrition

The number of aircraft that will be lost in a particular day can be estimated. This requires the inputting of an exchange ratio of some sorts. These aircraft can be deducted from the appropriate carrier's deck load. This may require the remaining planes to fly at a higher sortie rate in order to maintain a required sortie profile. This may be a theaterwide problem and not necessarily specific to a particular carrier. That is, attrited sorties will require aircraft on all carriers in a particular theater to be used more intensively. Of course, aircraft attrition could lead to a force structure problem which means that there are not sufficient aircraft to meet the requirements.

Lastly, a resupply of aircraft logic could be built into the model. As a carrier's aircraft are depleted, new fighters are dispatched from fleet inventories, if such "supplies" actually exist.

b. Float Attrition

The CFSM allocates all float inventory to a particular carrier. It is important to keep in mind that these inventories represent both the carrier's on-deck inventories and these inventories on adjacent AEs. It is assumed that all AE supplies can instantaneously be loaded onto the carrier.[1] A float attrition factor could be added that effectively reduces AE supplies due to AE attrition. Such a factor could be tied to target kill performance of T_1 threats. The worse that the T_1 kill performance is, the greater is the loss of AE inventories due to attrition. Such logic can also be expanded to carrier attrition.

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[1] It is also assumed that an AE's supplies can be loaded onto any carrier within the same theater. This assumption is implicit in the "aggregation logic" when theater supplies are obtained by summing the supplies of all deployed carriers to that theater.

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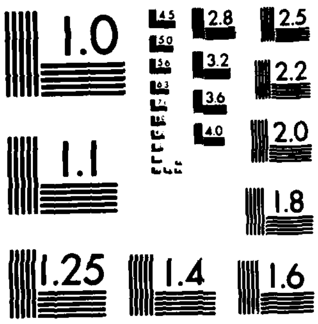

MICROCOPY RESOLUTION TEST CHART
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c. Float Inventory Requirements

The model could be constrained so that a requirement is built into it that carrier and AE inventories never fall below a specified amount. The amount represents the minimum level required for the carrier to defend itself against an attack. Such logic would be tied into the resupply module of the prototype. This would effectively mean that pipeline movements of missiles are allocated first to ships below a "safety net" figure; then to "hot theaters", and finally on the basis of "fair share."

V. FUTURE DIRECTIONS

A. Introduction

The methodology that is described in this report is an excellent basis for continuing capability assessment. This section describes a framework for expanding the work to extend its applicability to different logistics components, different aircraft, different Navy offices for use, and wider applications of the model.

This expansion path focuses on the CAPLOG Model. It presents a series of model expansions which include incorporation of an expanded version of the munitions work presented in this report. In addition, expansion of this capability assessment modeling would be greatly enhanced by a comprehensive Navy logistics capability and requirements model. This section describes such a capability overview system and then lists refinements to the CAPLOG Model, including incorporation of munitions.

B. Navy Capability Overview System

Step 1 - Design a Navy Logistics Capability and Requirements Oversight Module as Part of the CAPLOG System

Develop a manual prototype information acquisition and integration system for OP-964 and for NAVSUP to collect logistics capability information system on all aspects of NAVAIR and build preliminary working hypotheses of numerical results based on expert judgment, existing logistics capabilities for major logistics input factors including reparable spares, munitions, TRAP, maintenance manpower, consumable spares and other factors.

The system will have the flexibility to include multiple sources of information within the Navy ranging from information on specific battle groups to Navy-wide information about certain logistics inputs. The system will focus on aggregate supply characteristics for individual weapon systems and take account not only of existing capabilities but those that might be logically forecast to exist as a result of past and projected resources applied to various problems. This capability will take a graphical approach and address the information requirements of the Materiel Readiness Reports and the major warfare roles of the Navy. Undertake preliminary and exploratory steps to automate these capabilities and explore automated methods of linking the individual pieces of capability information obtained through this process.

Focus attention on this method as a vehicle of stating concisely the needs for information the Navy has and exploring uses of this tool to prioritize information gathering and research efforts.

Step 2 - Revise the Preliminary Methodology and Begin to Implement It with Realistic Data and Expand the Automation

Thoroughly revise and augment all methodology project concept developed in Step 1 based on the preliminary results. In addition, augment the analysis so that it could be used not only for resourcing but also for crisis management. Identify a reasonably wide range of contingencies and circumstances affecting logistics capabilities. Develop crude working hypotheses based on expert judgment, likely results for each, focusing on order of magnitude of the sizes of problems of differnt sizes, using this methodology to insure large and high-priority problems are addressed first. Lower magnitude problems that are critical are dealt with in a balanced and comprehensive fashion.

Expand the automation of preliminary results and explore automated linkages, particularly where aggregation of individual unit or battle group results are required for fleet commands or for Navy-wide analysis results. Initial versions of this work will be forced to be completely consistent with

NAVSUP requirements in funding decision analysis. They will also be used to analyze operations plans from a logistics point of view.

Step 3 - Explore Decision Applications of the New Approach

Identify two or three major policy, doctrine, resource requirement, or resource priority-application decisions that the Navy is considering or that are suggested by preliminary analyses in the modeling approach. Work with Navy program offices and with Navy programmers on these real-life situations they are facing and utilize the conceptual approach, the manual graphics results and possibly quick-response automated products to test the methodology and see whether assistance can truly be offered to practical situations.

Step 4 - Balanced Program Analysis

Develop automated methods to simultaneously show Navy capabilities for reparable spares, munitions and POL.

C. CAPLOG Expansion

The possibilities for expansion of the CAPLOG Model are listed in separate steps as follows.

Step 1 - Expand Coverage of the CAPLOG Model to Other TMSs

The data base development work that was done for the F-14 must be repeated for four to five other major battle-group aircraft. This expansion will build upon the F-14 work and incorporate improvements in the data base extraction procedures resulting from the F-14 data-scrub effort. These additon TMSs should be incorporated into the CAPLOG Model, in the following priority: A-6; S-3, A-7; and P-3. In addition, an initial survey will be done to determine if adequate data are available for the F/A 18. If data are available for this weapon system, it will be added to the data base between the S-3 and the A-7. As part of this task, the indenturing problem and its relationship to common spares will be addressed.

Step 2 - Develop a Methodology for Including Consumables Into the CAPLOG System

A methodology needs to be developed for including consumable spares in the CAPLOG Model. This will require investigating indenturing relationships between consumable and reparable spares. These data presumably exist to make the linkup in ASO data systems. If these data are not available to allow explicit linkages to be developed, an alternative factoring methodology will be employed to develop a feasible alternative approach for including consumables. All data bases or algorithms used in the approach will be documented.

Step 3 - AVCAL Analyses Using the CAPLOG Model

Using the F-14 CAPLOG prototype, specific analyses will be developed for one AVCAL and capability estimates provided for one battle group. Specific issues to be addressed include the likely benefits of full versus partial AVCAL's. In addition, the work will provide alternative capability assessment based on the efforts of having more than one AVCAL operating together. These synergistic AVCAL effects have not yet been studied in the necessary detail. This task will include a listing of assumptions, input data, and methodology.

Step 4 - Continued CAPLOG Testing and Refinement

The existing CAPLOG prototype will be used to continue a number of runs under a number of different likely scenarios and situations in the Navy. Experts from NAVSUP, the operation community, and other areas of the Navy deemed relevant will be consulted. These runs will help to develop a better baseline set of assumptions and circumstances which then can be applied to all TMSs when the data are available.

In addition to the testing of the model, logic improvements are required. A more sophisticated flying program input module is required. This will aloow changes to be made more easily in the flying program, and a more straightforward interface between these flying programs and the CAPLOG Model. In addition, specific algorithms to handle cannibalization in the model will be investigated in conjunction with NAVSUP personnel to develop a more realistic Navy set of assumptions for how to handly cannibalization in the CAPLOG Model.

Step 5 - Use of the CAPLOG Model to Suggest Required Changes to the NAMSO and ASO Data-Collection Systems

It has long been clear that some improvements will be required in Navy data-collection systems for reparable spares if a true capability-assessment system is to be developed. The CAPLOG Model is an extremely useful tool for determining which data elements are sensitive and which require change immediately. Data elements will be identified which are acceptable but which could use long-term improvement. Using the CAPLOG Model to run sensitivity runs in conjunction with detailed work and interviews with NAMSO and ASO personnel will yield a CAPLOG master data base plan. This master data base plan shall include a set of necessary steps to improved Navy data-collection system to support credible capability assessments. This plan will include priorities and magnitudes of the problem and recommended solutions. It will present options for time-phasing and the specific benefits of making the improvements and specific costs of not making the improvements in terms of credible capability-assessment results. This plan will be fully coordinated with NAMSO and ASO personnel and with any ongoing Navy efforts to improve these data.

Step 6 - Integration of the CAPLOG Spares and CAPLOG Munitions Work

Specific linkages will be developed to provide a balanced program framework for CAPLOG modules. This will also show how consistent operational activity levels can be fed into the munitions and spares side to generate consistent capability charts for tying the capabilities of both resource areas. This work will be done manually initially with an automated linkage program specified.

This work should include the linkage methodology and show prototypical results in a balanced format of combining real results in one set of charts.

Step 7 - Develop Linkages Between the Initial CAPLOG Prototype and ASO Budgeting and Procurement Procedures

A set of linkages could be developed between the outputs of the CAPLOG Model and the current methods of requirements determination and procurement. These linkages will allow a prototype reconciliation between the outputs of the model and the official Navy requirements determinations.

As a result of this effort, algorithms and methodology will be specified which provide these linkages and reconciliations. In addition, a set of recommendations as to how NAVSUP and ASO could, in a prototype fashion, develop a more capability-oriented requirements-determination process which would allow them to more explicitly link capability-assessment models such as CAPLOG to their processes.

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